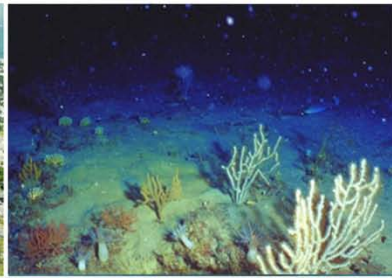




Key West Harbor



Reconnaissance Report

November 2010

U.S. Army Corps of Engineers

Jacksonville District

KEY WEST HARBOR RECONNAISSANCE REPORT

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Key West Harbor Reconnaissance Report

EXECUTIVE SUMMARY

The reconnaissance study has resulted in the finding that a Federal interest in National Water Policy and economic development exists for Navigation improvements to Key West Harbor. Project implementation and thus further study would however, require relief from regulations implemented under Public Law 101-605 which prohibits "...drilling into, dredging or otherwise altering the seabed of the Sanctuary (Florida Keys National Marine Sanctuary)." 33 CFR 922.163(a)(3). The City of Key West has expressed interest in becoming the cost-sharing sponsor for the feasibility phase of the study. The City indicates a desire to use this analysis as documentation for a request to their Congressional representatives asking for modification, or a waiver for one time relief from regulations implemented under Public Law 101-605.

The City of Key West noted in their July 24, 2008, letter that channel constraints were increasingly restricting vessels from transiting the channel. The Key West Bar Pilots Association (KWBPA) letter of November 13, 2007, also indicated a marked decline in passenger ship port calls with further declines forecasted due to an existing Cut B navigation channel width constraint of 300 feet. The City of Key West and the KWBPA believe that the decline in passenger ship traffic results primarily from the cruise ship industry's trend of gradually replacing smaller cruise ships with larger passenger vessels in the Caribbean market. The larger vessels have increased lengths, widths, and sometimes drafts which prevent them from entering Key West Harbor, especially under unfavorable crosswind and crosscurrent conditions. The reconnaissance study supports the assumption that with a wider channel additional cruise ships would be able to transit safely under a wider range of weather conditions.

This study recommends widening Cut B from 300 feet to 450 feet at the existing U.S. Navy constructed depth of 34 feet (34 feet plus an additional two feet of advance maintenance). The KWBPA confirmed the additional 150-foot width will allow existing and future cruise ships to safely enter Key West Harbor. It is estimated that dredging and disposal would cost roughly \$5 to \$6 million, environmental considerations and potential impacts to hardbottoms would cost roughly \$23 million, and non construction items \$6 million, making total project cost up to \$35 million, depending on the extent of construction and on the method of disposal. The estimates employ an array of parameter and forecast assumptions ranging from low to high. Depending on the assumptions used, benefits range from \$4.6 million dollars average annual benefit to \$58 million dollars average annual benefit. Potential benefit-to-cost ratios range from 2.4 to 29.3.

Key West Harbor Reconnaissance Report

1. STUDY AUTHORITY

a. This study analysis was prepared at the request of the U.S. Navy and the City of Key West. The City of Key West is wanting this report to be in response to the Resolution, Docket [Docket 2777], of House Committee on Transportation and Infrastructure adopted May 23, 2007 for Key West Harbor, Florida, which reads as follows:

“Resolved by the Committee on Transportation and Infrastructure of the United States House of Representatives, that the Secretary of the Army is requested to review the report of the Chief of Engineers on the Key West Harbor, Florida, published in Senate Document 106, 87th Congress, 2nd session, and other pertinent reports, to determine whether modifications to the recommendations contained therein are advisable with particular reference to widening the navigation project at the present time at Key West Harbor.”

Funding for this study was not appropriated through traditional Civil Works procedures, but through the U.S. Navy and Work for Others Program. This Reconnaissance Report is identical in scope and format to the Civil Works Section 905(b) Analysis, however additional considerations will be required to transition from the Work for Others to Civil Works Program to continue on to a Feasibility Phase.

2. STUDY PURPOSE

The purpose of this reconnaissance study is to determine if there is a Federal (Corps) interest in participating in a cost shared feasibility phase study to examine navigational improvements to Key West Harbor. The reconnaissance study has resulted in the finding that significant environmental impacts and legal challenges would have to be overcome in order to implement channel improvements. Additionally, the economic feasibility will require extensive documentation to support a potential Federal investment decision, pending relief from regulations implemented under Public Law 101-605 which prohibits “...drilling into, dredging or otherwise altering the seabed of the Sanctuary (Florida Keys National Marine Sanctuary).” 33 CFR 922.163(a)(3). However, as a result of preliminary economic analyses, there does appear to be a significant Federal interest for national economic development in pursuing channel improvements at Key West Harbor. The purpose of this analysis is to document the basis for this finding and establish the scope of the feasibility phase.

3. LOCATION OF STUDY, NON-FEDERAL SPONSOR AND CONGRESSIONAL DISTRICTS

a. Key West is an island between the Gulf of Mexico to the north and the straits of Florida to the south, about 130 airline miles southwest of Miami, and 230 miles south of Tampa, Florida. The City of Key West occupies the entire island, three square miles. The Key West Harbor and Channel, the subject of this report, is located on the far west portion of the island with the main channel approach from the south, refer to **Figures 1 and 2**.

b. The City of Key West has expressed interest in becoming the non-federal sponsor for the feasibility phase of the study.

c. The study area lies within the current jurisdiction of Congressionals Ileana Ros-Lehtinen (18th District), U.S Senators George LeMieux and Bill Nelson, Florida State Senator Larcenia J. Bullard (39th District), and Florida House of Representative for Monroe County Ron Saunders (120th District).



Figure 1: Map of Project Location

Source: <http://www.floridakeys-keywest.com/images/Florida.Keys.Map.jpg>



Figure 2: Key West Channel and Previously Mapped Environmental Hardbottoms

4. PRIOR REPORTS AND EXISTING PROJECTS

a. The following reports were reviewed as a part of this study; refer to **Figures 3** and **4** for location identifications:

- 1) U.S Navy Dredging Project of 2003 and 2004 (SAJ Contract No. DACA17-03-C-0001, awarded 12 Sep 2003) provided for two feet of advance maintenance in the 34-foot project; Main Ship Channel, Cut-A, Cut-B, and Cut-C.
- 2) November 17, 1988, under Public Law 99-662, work included de-authorizing two uncompleted jetties at the Northwest Channel.
- 3) In 1964, under General and Detail Design Memorandum March 18, 1966, the U.S. Navy constructed a 12-foot by 150-foot Key West Bight Channel to a depth of 12 feet Mean Low Water (MLW). The U.S. Navy also deepened the main ship channel to 34 feet from the entrance to the Navy Submarine Base and deepened the turning basin to the Navy Docks to 30 feet.
- 4) Bight Channel report dated October 1962, involved construction of a 12 by 50-foot channel extending off of the Main Key West Channel, a turning basin, and an 800-foot long granite-mound breakwater on the north side of Bight Channel.
- 5) In July 1960, Garrison Bight Channel was proposed for construction. The channel extended 100-feet wide by eight feet deep along the north and east sides of Fleming Key. The Channel was approved for construction under Section 107 of the 1960 River and Harbor Act on March 1, 1963.
- 6) Intracoastal Waterway from Miami to Key West was only partially completed, Authorization from House Document 742/79/2, in 1945 to a depth of seven feet for a length of 90 feet and stopped due to environmental concerns.
- 7) From 1942 to 1943, the U.S. Navy extended the 30-foot channel to a deepwater turning basin at the Key West Naval Operating Base.
- 8) An area, known as the Middle Ground, was removed, **Figure 3**, with authorization from House Document 185/65/1, in July 1918.
- 9) The Main Channel and anchorage, dimensions of 30 feet by 300 feet was authorized for construction in July of 1912 by House Document 706/62/2.
- 10) Removal of reefs in the Main Channel was approved in May 1908, with the report Main Ship Channel Reef Removal.

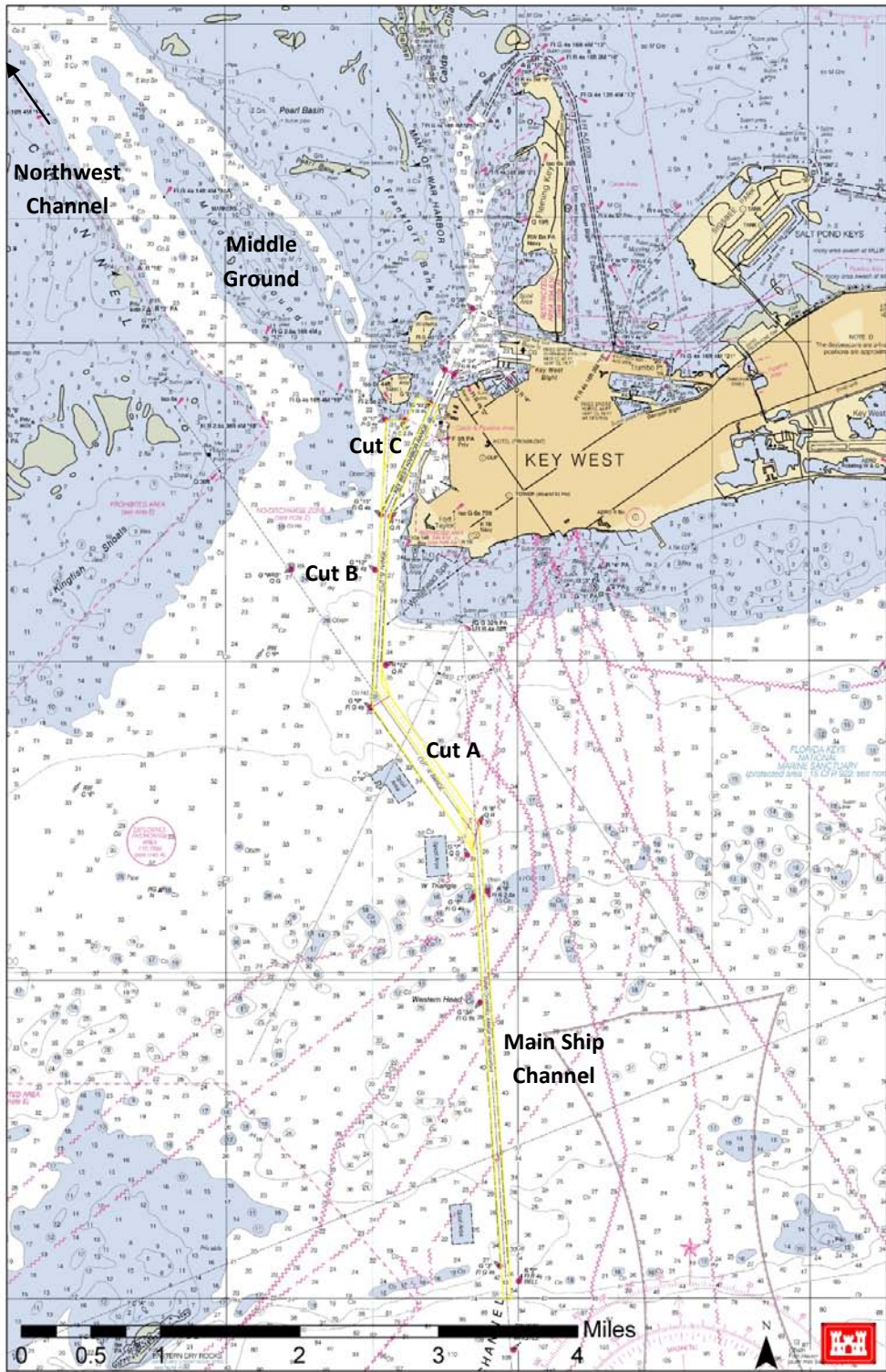


Figure 3: Nautical Chart of Project Area and Federal Channel

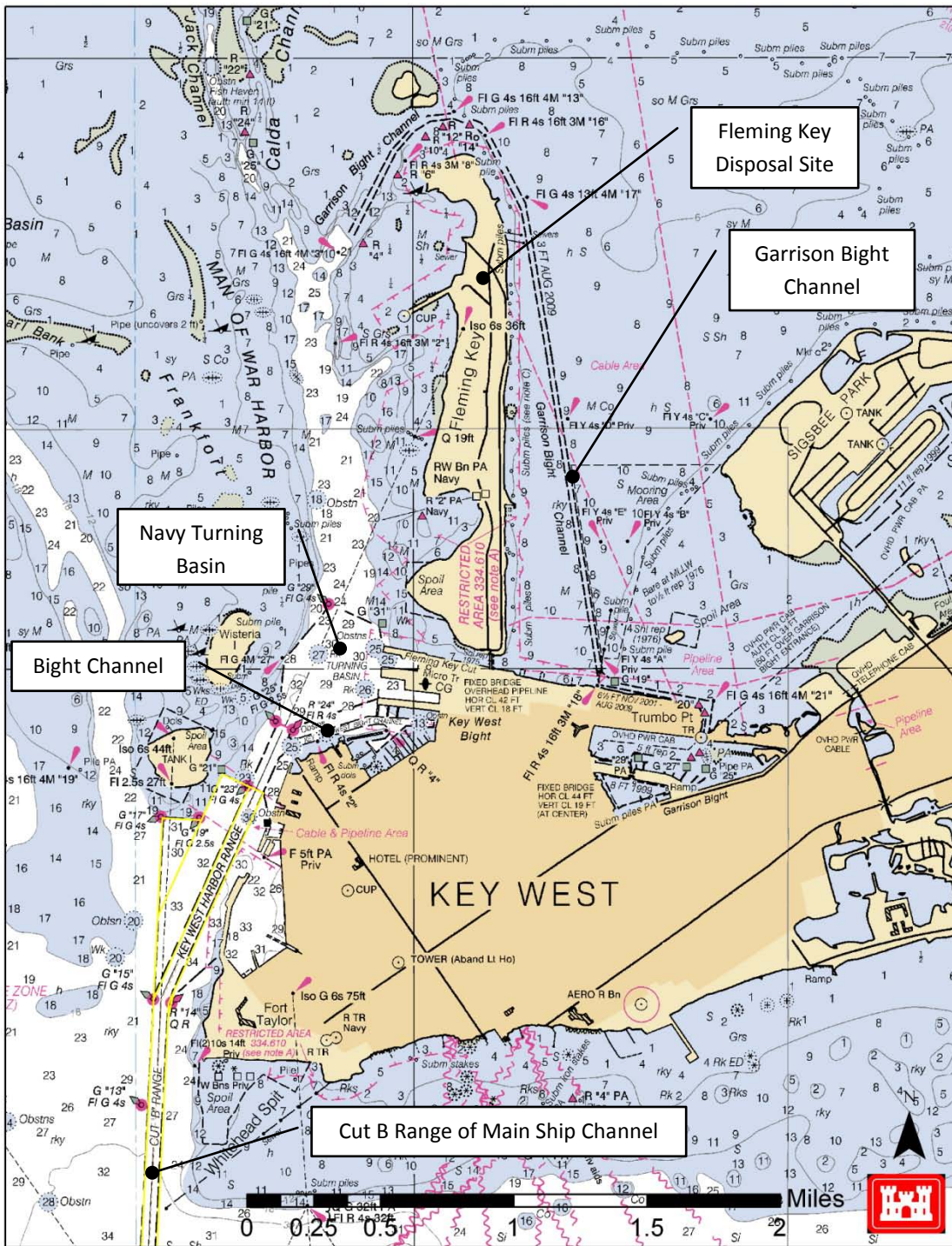


Figure 4: Upper Key West Harbor and Previously Constructed Measures

11) The Northwest Entrance Channel, report produced September 19, 1890, was deepened to 17 feet, with authorization from House Document 145/50/2 and House Executive Document 39/51/1.

This study is investigating potential modifications to previous project authorized channel width dimensions of 300 feet, as a result of an increase in the size of vessels that could most commonly call at Key West Harbor.

5. PLAN FORMULATION

During a study, six planning steps set forth in the Water Resource Council's Principles and Guidelines focus the planning effort and lead to the eventual selection of a recommended plan for authorization. The six planning steps are: 1) specify problems and opportunities, 2) inventory and forecast conditions, 3) formulate alternative plans, 4) evaluate effects of alternative plans, 5) compare alternative plans, and 6) select recommended plan. During the reconnaissance phase, the step of specifying problems and opportunities is emphasized. That is not to say, however, that the other steps are ignored since the initial screening of preliminary plans that results from the other steps is very important to the scoping of the follow-on feasibility phase studies. The sub-paragraphs that follow present the results of the iterations of the planning steps conducted during the reconnaissance phase. This information will be refined in future iterations of the planning steps during the feasibility phase.

A. NATIONAL OBJECTIVE

The national or Federal objective of water and related land resources planning is to contribute to national economic development consistent with protecting the nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements. Contributions to National Economic Development (NED) are increases in the net value of the national output of goods and services, expressed in monetary terms. Contributions to NED are the direct net benefits that accrue in the planning area and the rest of the nation.

B. PUBLIC CONCERNS

A number of public concerns have been identified during the course of the reconnaissance study. Enclosed letters written by the City of Key West and the Key West Bar Pilots presents the current study request and document navigation safety concerns (Attachment 1). These initial concerns are captured in the study authorization. Additional input was received through coordination with the U.S. Navy, U.S. Coast

Guard, environmental interest groups, and the City of Key West who attended the November 12, 2009, study kickoff meeting at the City of Key West offices. The public concerns that are related to the establishment of planning objectives and planning constraints are:

1) Navigational safety concerns associated with strong and unpredictable wind, wave, and crosscurrent conditions of Key West Harbor due to existing Federal channel width constraint of 300 feet. Under such wind and current conditions a vessel similar in dimension to the Royal Caribbean Freedom Class Cruise ship, with a length of 1,112 feet, a beam of 127 feet, and a draft of 29 feet, might steer a course such that the resultant velocity vector of the ship remains aligned within the channel, (**Figure 5**). The difference between the steered course heading and the resultant velocity vector of the ship is referred to as a crab angle, which will result in an increase in the ship's effective beam proportional to the degree of crab angle the ship is steered. For the Freedom Class Vessel, six degrees of crab angle results in an effective beam of 236 feet, which would make transit through the 300-foot channel unsafe, and therefore vessels of these dimensions do not call at Key West Harbor.

2) Economic stimulation from passenger vessel tourism. Key West's local economy relies heavily on the seasonal and annual economic engine of the cruise ship industry.

3) Environmental resource impacts, direct and indirect, resulting from channel widening and deepening.



Figure 5: Theoretical representation of Royal Caribbean Freedom Class Vessel

C. PROBLEMS AND OPPORTUNITIES

The evaluation of public concerns often reflects a range of needs, which are perceived by the public. This section describes these needs in the context of problems and opportunities that can be addressed through water and related land resource management. For each problem and opportunity, the existing conditions and the expected future conditions are described, as follows:

1) Existing Conditions

Key West, as shown in **Figures 1 and 2**, is in Monroe County, FL, and is the southernmost city in the continental U.S. The cruise ship market has become an increasingly common, affordable, and easy way to visit the small U.S. Caribbean city. Prior to 1982, there were neither passenger vessels nor cruise ships frequenting Key West Harbor, and the market for cruise ship travel and tourism was just beginning to take hold in the Caribbean. Since the 1980s, the industry has shown exponential growth with Key West Harbor becoming a major tourism spot with over 1 million tourists visiting the city in 2003 alone. Key West's \$69 million dollars of cruise tourism expenditures represented 3.9% of the overall Caribbean market during the 2005-2006 cruise season. The city's

main industry is tourism and recreation, though a large U.S. Navy presence is also important economically. Historically, the city has received considerable economic benefit from visiting cruise vessels including increased jobs and income. Docking fees and tax revenues are a highly significant source of revenue for the municipal government. As of 2005, the cruise industry in Key West was responsible for \$68.7 million dollars of direct economic activity, 1,260 local jobs¹, and approximately 15% of the City's annual tax revenue².

With cruise ships setting their schedule a year or more in advance, local business owners in Key West have grown to expect the routine and somewhat seasonal burst of tourism. Technological advances and efficiency of vessel design are resulting in wider, longer, and sometimes deeper drafting vessels that can carry more passengers and offer more desired amenities onboard. The International Convention of the Safety of Life at Sea (an International Treaty since 1974) requires fire safety upgrades for all passenger vessels. The original fleets from the 1980's and 1990's are required to abide by safety regulations such as this one, and as a result are being replaced by the newer, safer, and much larger vessels. The older, smaller, vessels are being phased out of the Caribbean market and relocated around the globe.

WIND AND CURRENT CONSIDERATIONS

Based on discussions with the Key West Bar Pilots, wind magnitude and direction is a viable cause for the delay, cancellation, or non-booking of cruise ship calls throughout the year. In order to examine this concern, existing data from the offshore NOAA buoy, SANF1, was analyzed. The SANF1 buoy is maintained and operated by the National Data Buoy Center and is located at 24.460 N 81.880 W (24°27'36" N 81°52'47" W). Existing data ranged from 1991 to 2009 and included hourly average wind speeds and direction. Using the common cardinal direction and degree direction (**Table 1**), inference was made as to prominent wind directions, average speeds, and diurnal patterns.

¹ F-CCA, *Economic Impact of Cruise Tourism on the Caribbean Economy*, 2006

² *The Impact of the Cruise Ship Industry on the Quality of Life in Key West*, Thomas J. Murray & Associates, Inc., 2005

Table 1: Wind and Wave Analysis for Key West from 2005 to 2008

Wind Direction Bins	Frequency	Cardinal Direction	Degree Direction
22.5	8%	N	348.75 - 11.25
45	11%	NNE	11.25 - 33.75
67.5	11%	NE	33.75 - 56.25
90	17%	ENE	56.25 - 78.75
112.5	13%	E	78.75 - 101.25
135	9%	ESE	101.25 - 123.75
157.5	5%	SE	123.75 - 146.25
180	3%	SSE	146.25 - 168.75
202.5	3%	S	168.75 - 191.25
225	2%	SSW	191.25 - 213.75
		SW	213.75 - 236.25
		WSW	236.25 - 258.75
		W	258.75 - 281.25
		WNW	281.25 - 303.75
		NW	303.75 - 326.25
		NNW	326.25 - 348.75

For the period of record from 2005 to 2008, (temporally selected for comparison with available ship logs), nine events occurred with sustained winds over 35 knots. Wind speeds of 30 to 35 knots were noted by the pilots as an upper threshold for which transiting the channel under these wind speeds in combination with strong and variable currents poses serious safety concerns and can result in a cancelled Port call of the existing fleet. **Figure 6** documents these nine events and their direct correlation with tropical storms and hurricanes. The pilots also noted that under tropical storm or hurricane warnings, the Port will typically close altogether, and no ships will be brought in or out during this time of high sustained winds and currents.

Average wind speed from 2005 to 2008 was 12.4 knots, with maximum wind speed of 59.6 knots occurring during the 2005 Hurricane Rita, also shown in **Figure 6**. Predominant wind direction is from the east in Key West Harbor. Analysis showed that 50% of all winds recorded were from the NE to ESE direction (**Table 1**). Diurnal variation analysis of wind patterns show that wind speeds typically peak between 0300 and 0700 hours, and trough between 2000 and 2200 hours, but on average do not vary more than one to two knots over the course of the day.

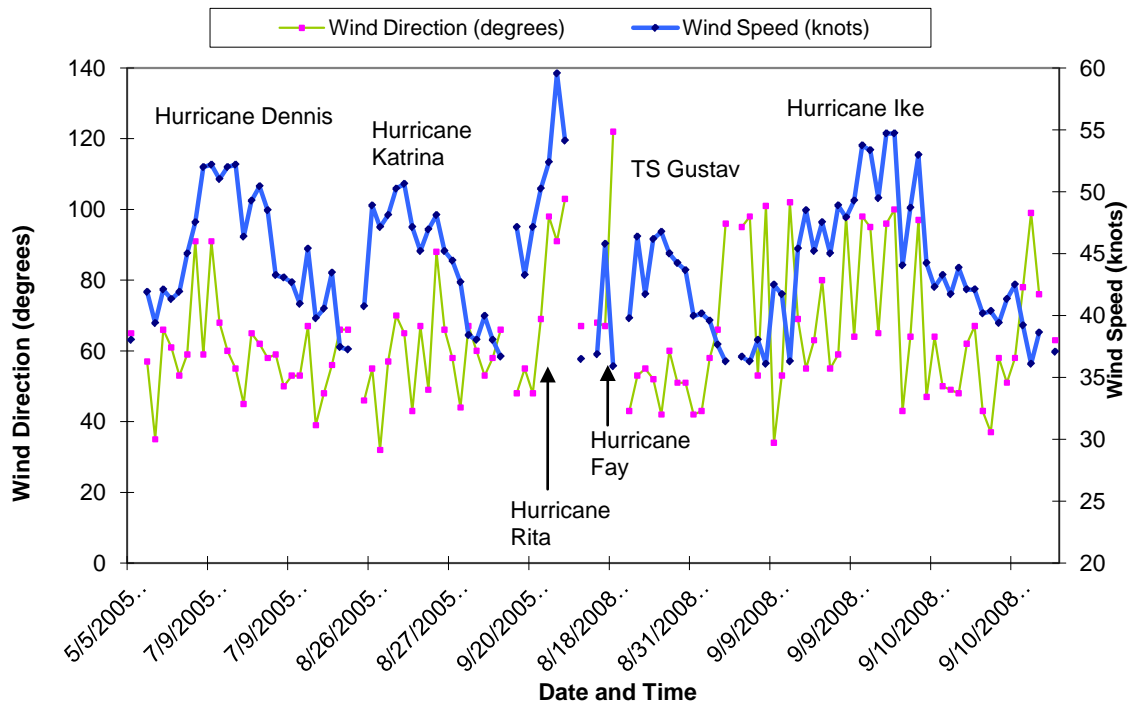


Figure 6: Key West Harbor Wind Directions and Speeds

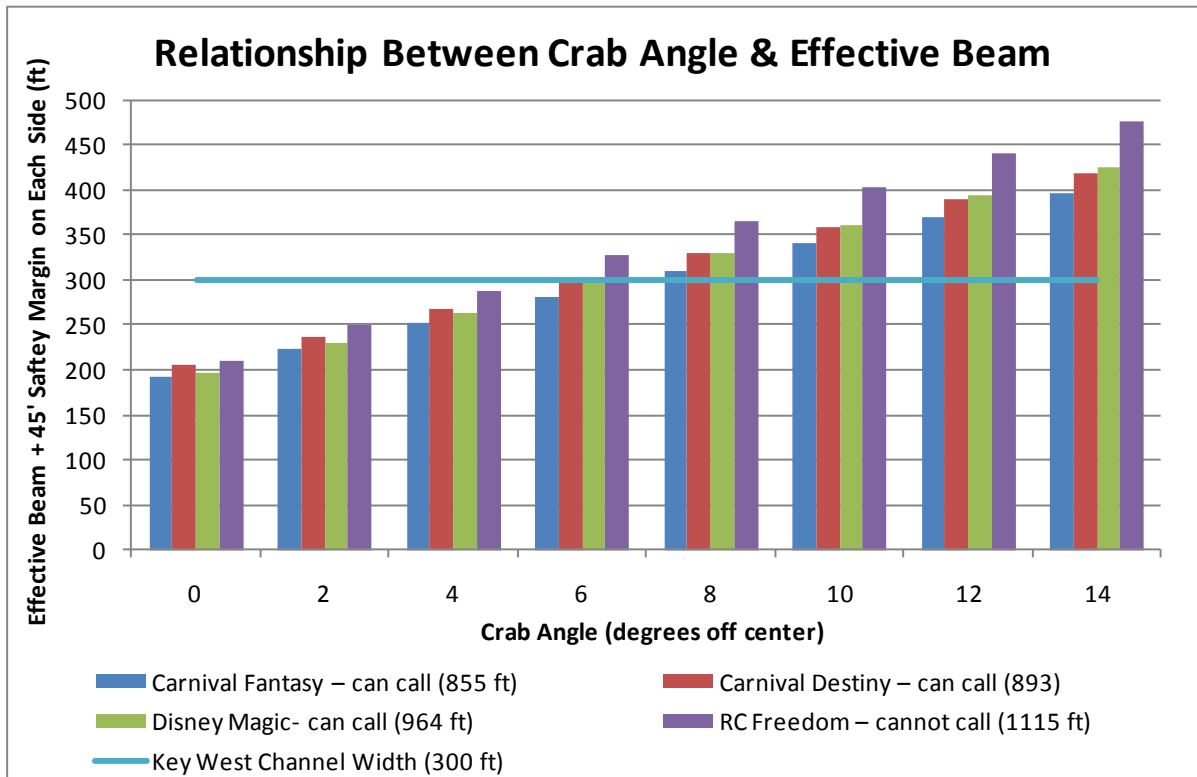
Based on this analysis for the existing fleet, wind speeds alone do not seem to be the limiting factor to vessel transit. The 300-foot wide Cut B in Key West Harbor Channel in combination with the vessel proportions and strong wind and water currents minimizes the pilot’s flexibility with which to crab the vessel. Under average 12.4 knot winds routinely blowing from the east, the larger vessels (typically with a length, beam, and draft of 1,112 feet, 127 feet, and 29 feet) cannot transit safely without high risk of drifting outside of the channel under crabbed conditions. The resulting effective beam of the ship increases from an existing beam of 127 feet to 236 feet, which prevents ships of that size from entering Key West Harbor as discussed in the Key West Harbor Pilots Association letter found in Attachment 1. **Table 2** and **Figure 7** show the relationship between crab angle and effective ship beam for four different vessel classes. The Carnival Fantasy and Destiny class can currently transit Key West along with the Disney Magic, however the Royal Caribbean Freedom Class cannot. At six degrees of crab angle, an upper threshold for the pilots, the unrestricted vessels have an effective beam of 200 feet; as compared to the 237-foot effective beam of the Royal Caribbean Freedom class under six degrees of crab angle. Without further analysis, including ship simulation, a

relationship between the crab angle, and thus effective beam, and wind and current thresholds cannot be conclusively determined at this time.

Table 2: Relationship Between Vessel Effective Beam and Crab Angle per (EM 1110-2-1613).

Vessel Class -- (Length)	Effective Beam + 45' Safety Margin on Each Side (ft)							
Carnival Fantasy – can call (855 ft)	193	223	252	282	311	340	369	397
Carnival Destiny – can call (893)	206	237	268	299	329	359	389	419
Disney Magic- can call (964 ft)	196	229	263	296	329	361	394	426
RC Freedom – cannot call (1115 ft)	211	250	288	327	365	403	440	477
Key West Channel Width (300 ft)	300	300	300	300	300	300	300	300
crab angle (degrees off center)	0	2	4	6	8	10	12	14

Note **Six degrees** of crab angle is the upper threshold as noted by the pilots.



(Add information on vessel width and draft to length in the above table)

Figure 7 : Crab Angle and Effective Beam amongst Current and Future Vessels at Key West Harbor

Interviews with knowledgeable stakeholders revealed no anecdotal history of groundings, collisions or other damaging events-at-sea in or near the Key West channel. Increases in safety and navigation technology combined with the increased economic costs of a potential grounding have resulted in a phenomenal safety record in Key West channel. In fact, some of the cruise vessels constrained from calling at Key West might be able to call there under ideal, no wind or wave conditions, but due to the average weather conditions of 12.4 knot winds and moderate to strong and variable cross currents, cruise ship companies have opted not to assume the increased risk of a delayed or cancelled port call on top of potentially grounding their vessels. The cruise ship companies require a consistent, fixed schedule for itinerary planning purposes and therefore require a large margin of safety so that they can continue to meet their schedule even under unfavorable conditions. Key West does not currently offer an adequate margin of safety for these newer, larger cruise ships to consistently call there.

ENVIRONMENTAL CONSIDERATIONS

The following is information taken from the *Environmental Assessment for Fleet Support and Infrastructure Improvements; Naval Air Station Key West*, U.S. Navy, 2003, and describes the available hardbottom information as documented in this report. While none of the species observed in 2003 were threatened or endangered, during the 2006 dredging event, the threatened staghorn coral (*Acropora cervicornis*) was seen within 1,500 feet of the channel.

“Biological resources surveys were conducted by Continental Shelf Associates, Inc. (CSA 2002) to characterize the benthic habitat and communities within the vicinity of the project area. Side-scan sonar data, diver observations, towed and diver held video camera data and still photographs were collected to assist in describing the project area. Data were collected from Truman Annex Harbor, the adjacent turning basin (Cut C), and the Key West Ship Channel (Cuts B and A, and the Main Ship Channel are illustrated in **Figures 3** and **4**). Also surveyed were areas adjacent to the Ship Channel extending out 1,000 feet on each side, and a 1,000-foot wide potential dredge pipeline route along the north side of Hawk Channel extending from Cut B east to Boca Chica Channel.

The vertical walls along the channel edges at the northern end of Cut B range in height from approximately two to three feet up to eight feet. The walls are colonized by hydroids; several species of tunicates; encrusting, branching and massive sponges; and occasional small scleractinian corals. Faunal abundance is highest near the upper edges of the wall with very low biotal cover near the bottom. Tunicates species include *Eudistoma* sp. and *Didemnum* sp. and other unidentified encrusting species. Sponges

include *Amphimedon compressa*, *Aplysina* sp., *Callyspongia vaginalis*, *Cinachyra* sp., *Lotrochota birotulata*, *I. Strobilina*, *S. vesparium*, and several unidentified species. Scleractinian corals are not abundant on the walls, with small colonies of the branching coral *O. diffusa* and occasional small *S. radians* and *S. siderea* recruits. Most of the scleractinian corals have diameters of less than 10 centimeters (cm). The fouling soft coral *Carejoa riisei* is relatively abundant along the upper sections of the wall on the western side of the channel. Other epifauna include long-spine urchins (*D. antillarum*), pencil urchins (*Eucidaris tribuloides*), and small spiny lobsters (*P. argus*).

The rock surface extending from the top of the walls away from the channel is more heavily colonized with sponges, scleractinian corals, tunicates, and macroalgae. Sponge and tunicate species are similar to those observed on the vertical rock face. Scleractinian corals include *M. annularis*, *M. cavernosa*, *O. diffusa*, *Porites astreoides*, *S. radians*, *S. siderea*, and *Solenastrea bournoni*.

At the midpoint of Cut B, the ridge and groove features observed in the rock bottom in the turning basin were highly visible running across the channel, with red algae attached to the ridges. Epibiota increased at the southern end of the cut, with the dominant cover an unidentified species of red turf-like algae, along with increasing numbers of sponges and small octocorals (*Eunicea* sp.). Overall, this section of the channel seemed to be highly disturbed by ship traffic, with a predominantly rubble-covered bottom.

An area of low-relief hard bottom was observed immediately to the west of the channel in Cut B. It was colonized by macroalgae, sponges, octocorals, and stony corals, with a species composition similar to the area west of the turning basin. Further to the west and southwest of the channel, sediments graded into sand with macroalgae and the seagrass *H. decipiens*. To the east of the Cut B channel, the bottom ranged from low-relief hard bottom (with algae, small sponges, and octocorals) to sand bottom.”

These identified hardbottom areas pose a high risk for vessel groundings immediately outside of the channel. Under crabbed conditions, this risk increases proportionally to the increasing effective beam of the vessel. As shown in **Figure 8**, the natural steep slopes of the Key West Harbor Channel diminish the margin of flexibility with which the vessel can drift outside the channel limits safely.

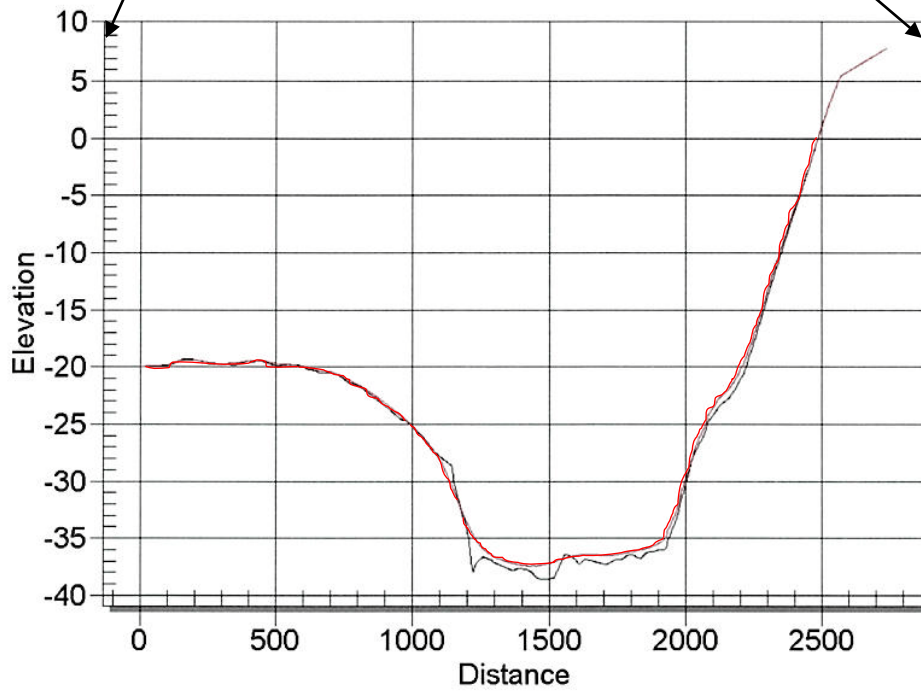
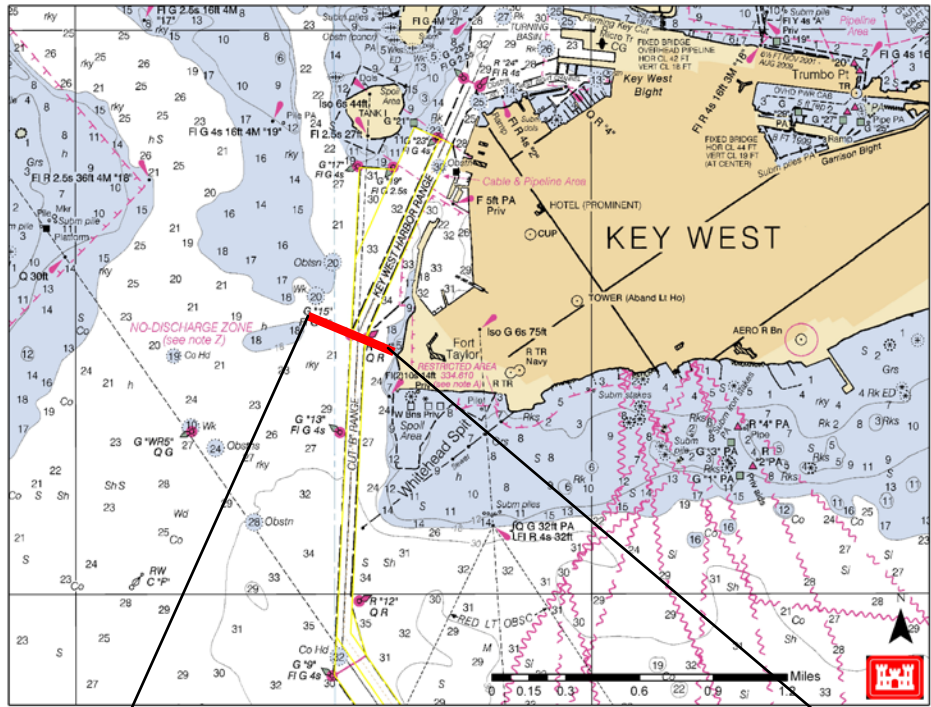


Figure 8: Cross Section of Key West Channel at Cut B/Cut C Channel Line from a 2005 Survey of Pre (black line) and Post (red line) Hurricane Rita

2) Future Without Project Conditions

Without a Federal channel widening project it is anticipated that no channel widening will occur. It is also anticipated that cruise ship size proportions will continue to increase as the cruise industry continues to grow and cruise companies continue to capitalize on economies of scale in the Caribbean market. This trend is expected to continue well into the future, further details can be found in **Appendix A**. Show past history for trend for regional fleet and those specifically calling on Key West on a recurring basis.

Royal Caribbean Cruises Ltd. (RCCL) and Carnival Corporation (CCL) represent the largest number of cruise lines that visit Key West. Over 90% of ships that visit Key West are from these two cruise ship companies.³ Royal Caribbean made some of its fleet statistics available for use in this study. Their data, in conjunction with interviews, supports the assumption that older, smaller passenger ship vessels will continue to be phased out of operation in the Caribbean market, and that the shift of vessel type will continue to be to the larger, wider, and potentially deeper drafting vessels similar to the dimensions of the Royal Caribbean Freedom Class, which cannot currently call at Key West due to channel configuration, (**Figures 5 and 7**). It is anticipated that these vessels will go to other ports of call that can accommodate the larger dimensioned vessels. This trend is anticipated to further limit the number of active vessels that are able to call at Key West Harbor. This limitation is due to the existing channel configuration and is set per pilot regulation that results from a threshold of the combined draft, beam, and length of a vessel.

3) Future With Project Conditions

Widening Key West Harbor in Cut B, one of the narrowest portions of the channel, would allow a greater number of the newer, larger cruise ships to transit the channel and dock at Key West Harbor. This would immediately benefit the local economy of the City of Key West due to profits generated by the tourism industry. Benefits of navigation improvements affecting cruise ships arise from more efficient ship operations and increased tourism or enhanced tourism experience. It is assumed that all benefits generated by the newer, larger cruise ship vessel are included as NED benefits, not Regional Economic Development (RED) benefits because Key West is a port of call competing with other international ports as opposed to regional U.S. ports. A further

³ Murray et al, *The Impacts of the Cruise Ship Industry on the Quality of Life in Key West, 2005*

detailed analysis and quantification of these national economic benefits is included in the economics **Appendix A** of this report.

D. PLANNING OBJECTIVES

The objective of NED is a general statement and not specific enough for direct use in plan formulation. The water and related land resource problems and opportunities identified in this study are stated as specific planning objectives to provide focus for the formulation of alternatives. These planning objectives reflect the problems and opportunities and represent desired positive changes in the without project conditions. The planning objectives are specified as follows:

- 1) Maximize NED benefits at Key West Harbor
- 2) Minimize navigational, environmental, and life safety risks associated with transiting the Key West Harbor navigation channels.

E. PLANNING CONSTRAINTS

Unlike planning objectives that represent desired positive changes, planning constraints represent restrictions that should not be violated. The planning constraints identified in this study are as follows:

1) Compliance with the Florida Keys National Marine Sanctuary and Protection Act (FKNMSPA) – Key West Harbor is currently located within the FKNMSPA designation boundaries (**Figure 9**). Project implementation would ultimately require relief from regulations implemented under Public Law 101-605 which prohibits “...drilling into, dredging or otherwise altering the seabed of the Sanctuary (Florida Keys National Marine Sanctuary)” 33 CFR 922.163(a)(3). Operation and Maintenance dredging to existing channel depth is however allowed, as these depths were authorized prior to the Sanctuary Designation in 1998. Under Existing Conditions and Future Without Project Conditions, the environmental resources that exist along the channel boundaries remain at risk to groundings under certain wind and current conditions. It is assumed that the resources that do exist in the bordering habitat are already degraded due to infrequent but damaging ship interactions. Proposed channel modifications which include widening, would have direct and indirect impacts to these documented environmental resources, but help provide the necessary buffer to preserve the healthy habitat existing outside of the zone of influence of current ship traffic.

2) Under the Endangered Species Act (ESA) of 1973; the threatened coral *Acropora cervicornis* (staghorn coral) and *Acropora palmata* (elkhorn coral) could be located adjacent to the channel in the areas proposed for expansion (**Figure 2**) as this area is designated as critical habitat for these species. While it is possible to relocate the actual colonies of coral, the critical habitat would be permanently removed. It is highly likely that the removal of several acres of occupied designated critical habitat (habitat where the species has been shown to be able to flourish under baseline conditions) could be considered an adverse modification of critical habitat under Section 7 of the ESA. This would be Jacksonville District’s first adverse modification of critical habitat determination in the last 15 years. It is also unknown what reasonable and prudent alternatives and measures National Marine Fisheries Service (NMFS) would include in a biological opinion to avoid the project adversely modifying designated critical habitat, as required under Section 7 of the Act. It is expected that resource agencies would oppose any channel modifications outside the existing footprint.

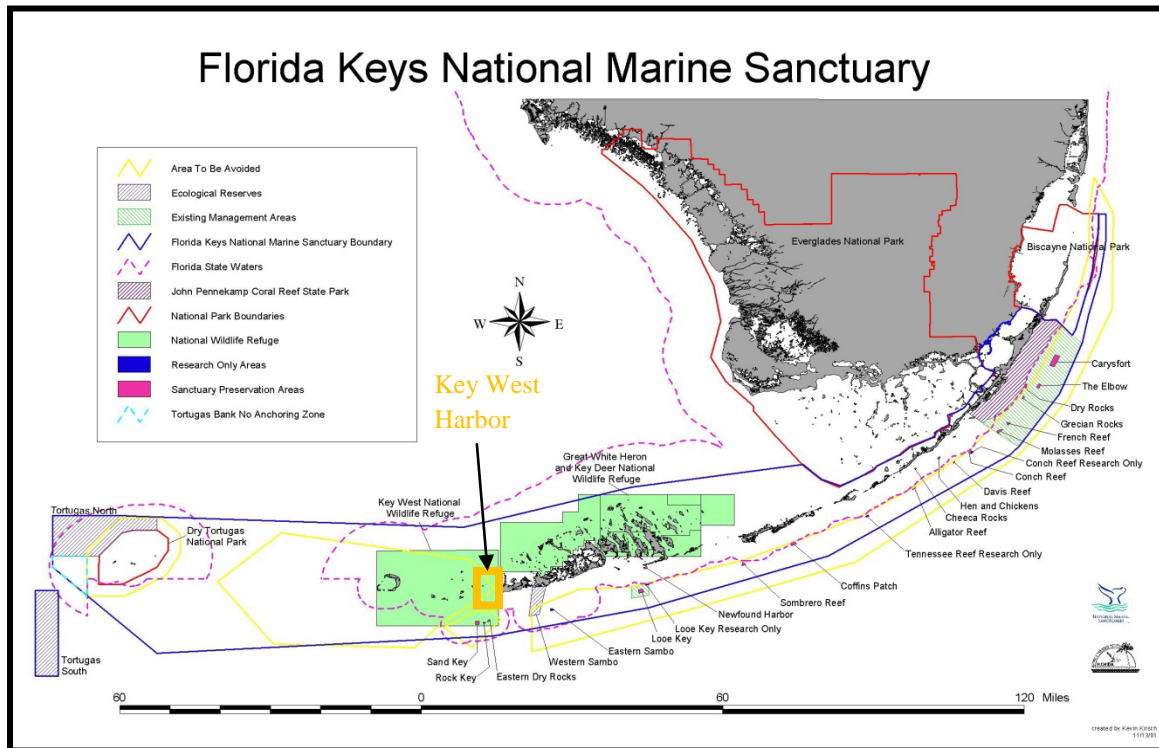


Figure 9: Florida Keys National Marine Sanctuary Map

F. MEASURES TO ADDRESS IDENTIFIED PLANNING OBJECTIVES

A management measure is a feature or activity at a site which addresses one or more of the planning objectives. A wide variety of measures were considered, some of which were found to be infeasible due to technical, economic, or environmental constraints. Each measure was assessed and a determination made regarding its retention in the formulation of alternative plans. The descriptions and results of the evaluations of the measures considered in this study are presented below:

(1) No Action

Federal water resources planning is required to consider the option of “No Action” as one of the alternatives in order to comply with the requirements of the National Environmental Policy Act (NEPA). No Action assumes that no project would be implemented by the Federal Government or by local interests to achieve the planning objectives. No Action, which is synonymous with the Future Without Project Condition, forms the basis from which all other alternative plans are measured.

(2) Non-Structural Measures

- a. Establish an outbound range (sector light) for Cut B. The KW pilots have submitted this request to the United States Coast Guard (USCG). The range has been designed and per standard Coast Guard Operation has been forwarded to USCG headquarters for approval and subsequent funding around \$1.2 to \$1.5 million. The USCG notified the Corps that it could take several years to secure funding for this measure. This range would provide additional assistance to the pilots to accurately line up inside the channel upon outbound transit.
- b. Removal of the remains of a former light tower base located NE of buoy #6. The remains of the structure and the surrounding area were deemed environmentally sensitive and the USCG was stopped from any effort to remove the structure. The obstructions’ shallow depth and close proximity to the edge of the ship channel make it a hazard to navigation.
- c. Repositioning of sea buoy KW 0.3 nautical miles south of current position to accommodate channel modifications. The USCG noted that a formal request by the pilots is all that is necessary to relocate this buoy. The repositioning of the sea buoy would help pilots accurately align with the entrance of the channel.

(3) Structural Measures

Extensive discussions with the KW Bar Pilots resulted in consideration of channel widening in Cut B. The Main Ship Channel and Cuts A and C do not appear to pose the same width restriction as in Cut B, due to the combination of existing width and cross current hydrodynamics in this channel cut area, but all cuts would be extensively analyzed during the feasibility stage. Alternatives considered to widen Cut B include alternative 1 and alternative 2, and a widener in the Main Ship Channel Cut A transition was also considered.

- a. Alternative 1: widen Cut B 150 feet from 300 feet to 450 feet by widening the channel 75 feet on the eastern and western sides of the channel to the existing project depth of 34 feet, (**Figure 10**).
- b. Alternative 2: widen Cut B 150 feet on the eastern side of the channel to the existing project depth of 34 feet, (**Figure 11**).
- c. Alternative 3: provide a 1,800 foot long transition from the Main Ship Channel to Cut A with a maximum width of 500 feet to the existing project depth of 34 feet, (this isn't navigable water but allowable over-depth), (**Figure 12**).

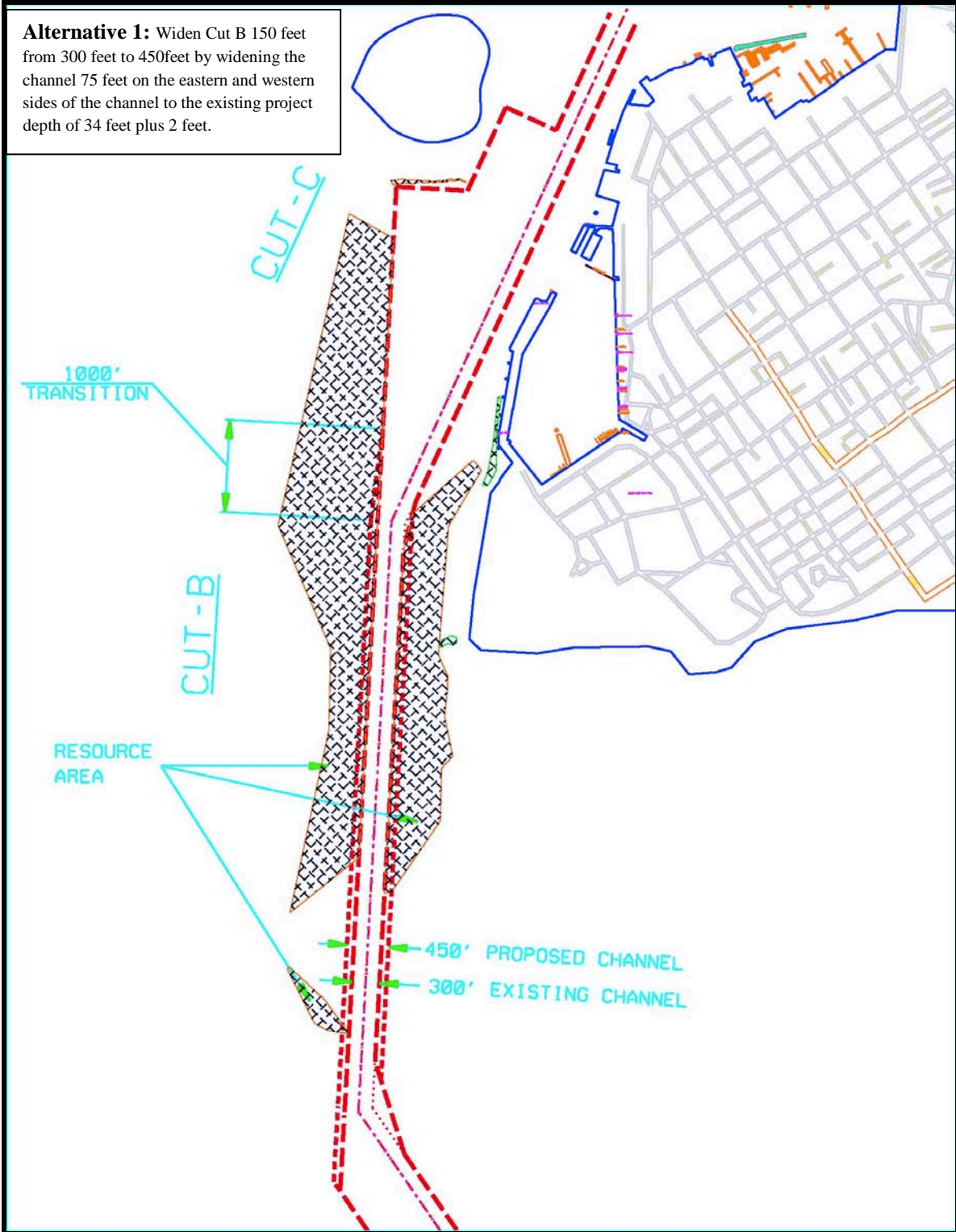


Figure 10: Alternative 1

Alternative 2: Widen Cut B 150 feet from 300 feet to 450 feet by widening the channel 150 feet on the eastern side of the channel to the existing project depth of 34 feet plus 2 feet.

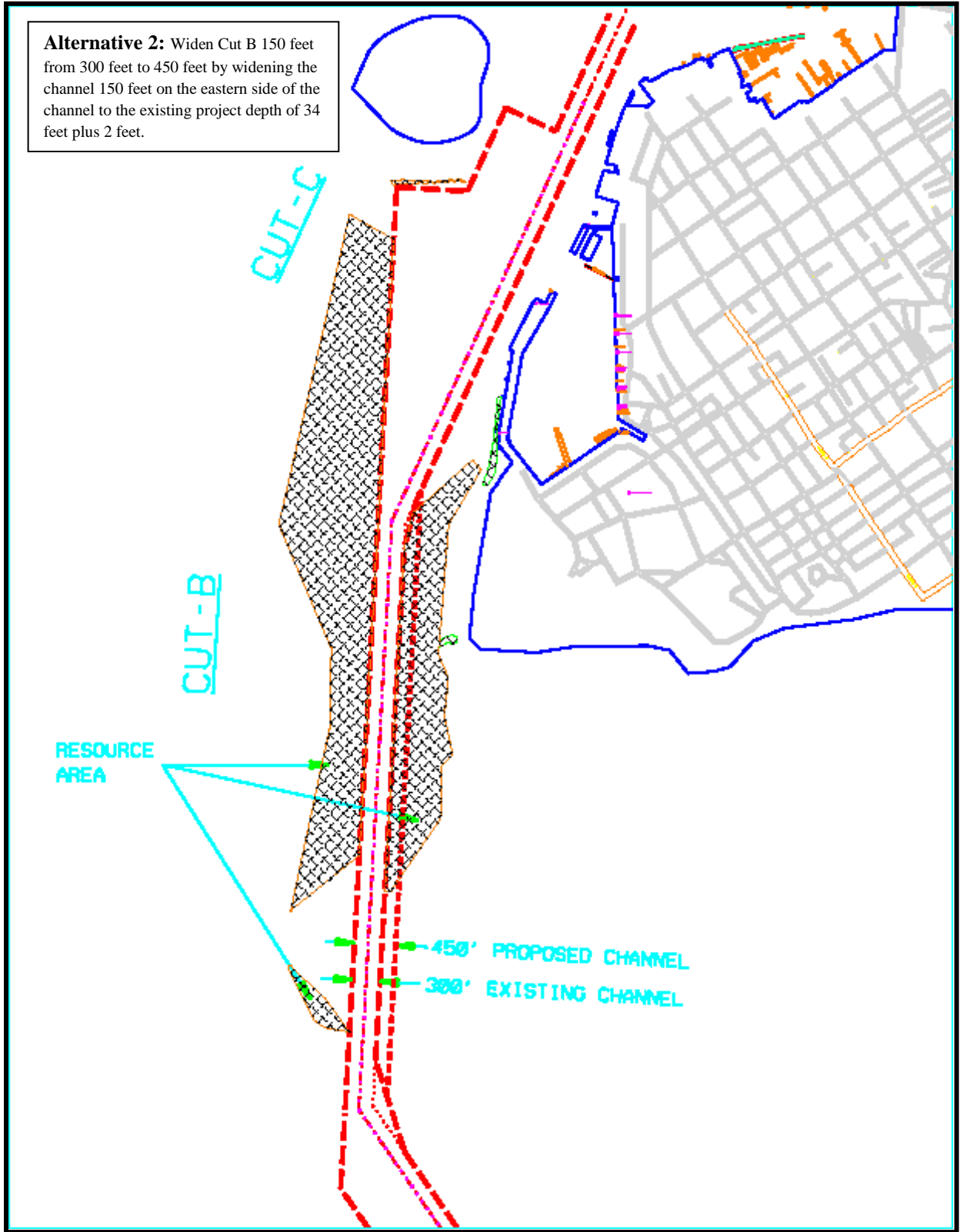


Figure 11: Alternative 2

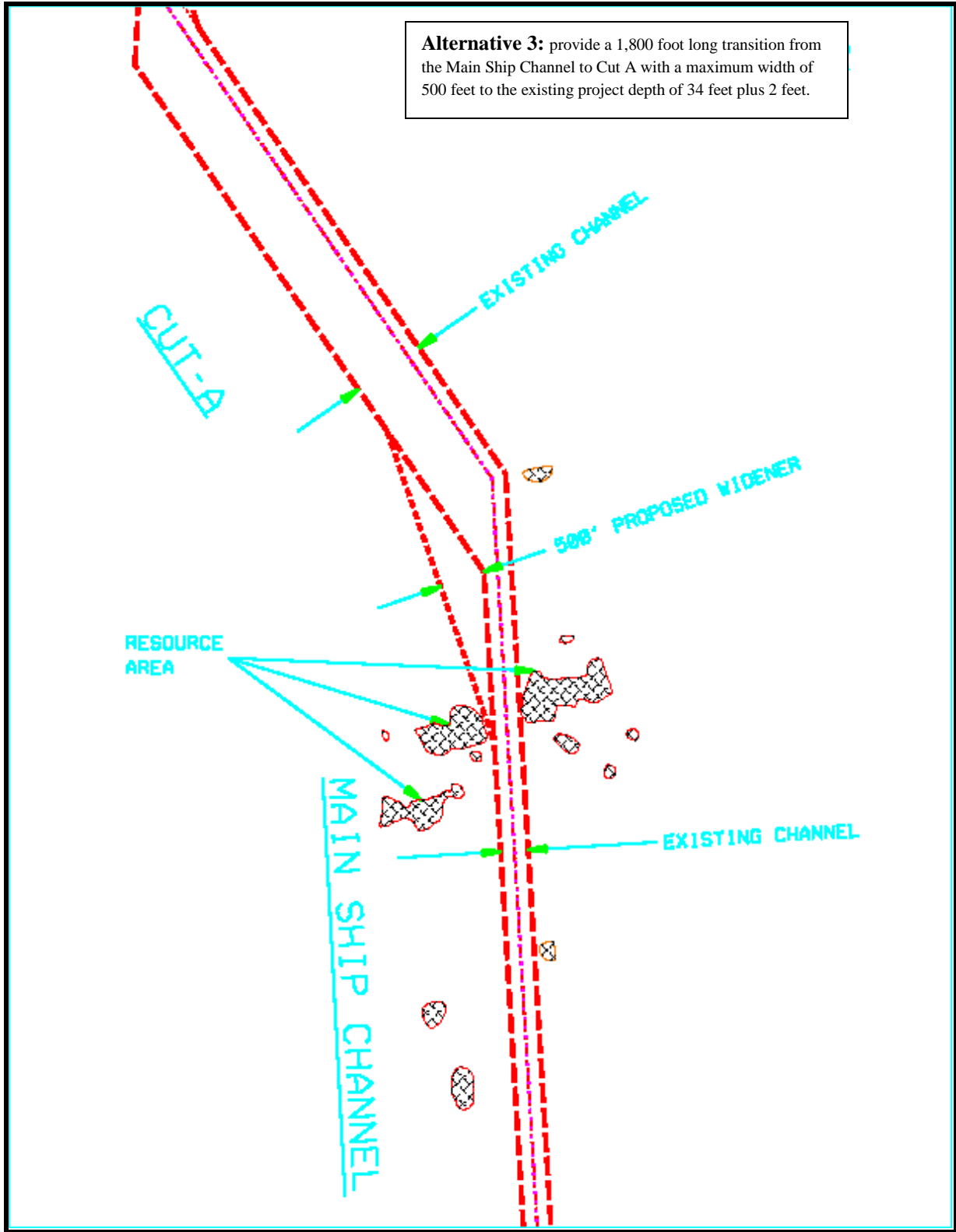


Figure 12: Alternative 3

Table 3: Preliminary Alternative Plans

		Material to be removed (cubic yards)^a	Resource Impacts (acres)^b	Est. direct + indirect impacts(acres)	Resource Description
	No Action	0	0	0	n/a
1	Widening to current project depth (34' +2') in Cut B 75 feet eastward (Buoys 12 to 14) and 75 feet westward (Buoys 9 to 15, w/1,000ft wedge)	151,000	14	25.2	sponge coral
2	Widening to current project depth (34' +2') in Cut B 150 feet eastward (Buoys 12 to 14)	149,000	13.7	24.7	sponge coral
3	Add 1,800 ft Channel Widener to current project depth (34' +2') (Buoy 7)	160,350	Not known.	~10	unknown

Notes

a. Quantities provided by J. Bearce (Qty_comps.xls 2feb2010)

b. Impact calculations using ArcGIS by L. Reichold (key_west_resources.mxd)

(4) Material Disposal Measures

There are at least three proposed options for disposing of the dredged material. In Options 1 and 2, construction dredging of each alternative could be accomplished with a Hydraulic Excavator Dredge that would load material into a split hull scow barge that would gravity deposit the material into a yet to be designated North or South Ocean Dredge Material Disposal Site (ODMDS), Disposal Options 1 and 2, respectively. Designation of an ODMDS requires extensive coordination and collaboration with the Environmental Protection Agency (EPA). Option 3 could be construction dredging with upland disposal into the Fleming Key Beneficial Use Site. This could be accomplished using a Hydraulic Excavator Dredge to load scow barges and shore operations to unload into the disposal site. This could include the installation of a mooring platform and/or mooring piles adjacent to the site. Estimated dredge volumes and resource impacts are presented in **Table 3**.

G. PRELIMINARY PLANS

Preliminary plans are comprised of one or more management measures that survived the initial screening. The descriptions and results of the evaluations of the preliminary plans that were considered in this study are presented below:

- 1) No measures were eliminated from further consideration, however not all measures satisfy all planning objectives.
- 2) Preliminary alternatives 1, 2, and 3 were selected for further consideration. Further exploration of alternative 3 is warranted to conclusively determine whether or not it satisfies all planning objectives.

H. CONCLUSIONS FROM THE PRELIMINARY SCREENING

The preliminary screening indicates that alternatives 1 and 2, involving channel widening in Cut B, have the greatest potential for reaping benefits from implementation. For this reason, and based on KW Bar Pilot input, calculated benefits, **Table 4**, are assumed applicable for alternatives 1 and 2, and it is unknown as to the benefits associated with alternative 3 and related non-structural measures.

The potential magnitude and types of benefits from the proposed channel modifications in Cut B employ an array of parameter and forecast assumptions ranging from low to high, **Table 4**. This range reflects the number of new cruise ship calls per year to Key West Harbor as a result of channel widening; low being two new ships calling per year to high being four new ships calling per year. Depending on the forecast used, benefits range from \$4.6 million dollars average annual benefit (AAEQ) to \$58 million dollars AAEQ.

Future with project conditions involving channel widening would likely reverse patterns of cruise ship traffic declines, and it is anticipated that there would be a return to pre-constrained levels within 18 months (due to cruise line itinerary planners planning 18 months ahead). The estimated benefits in this report are very conservative in that they assume a certain amount of cruise traffic returning and then no subsequent growth. The return of lost commerce, if realized, would likely include income, docking fees, and increased tax revenues. This return of economic activity to the U.S. from foreign competitors represents increases in National Economic Development (NED). In addition to benefits from returned cruise traffic, a Federal channel widening project may have a number of other benefits as well including consumer surplus, producer surplus, and increased public safety. **Appendix A** provides further detail regarding the economic analysis.

While it is possible to relocate the actual colonies of coral, the critical habitat would be permanently removed. It is highly likely that the removal of several acres of occupied designated critical habitat (habitat where the species has been shown to be able to flourish under baseline conditions) could be considered an adverse modification of critical habitat under Section 7 of the ESA. Alternative mitigation options might exist including water quality initiatives and stormwater management implementation. A feasibility study would explore these types of options in collaboration with the sponsor and interested stakeholders.

It is estimated that dredging and disposal would cost roughly \$5 to \$6 million, environmental considerations and potential impacts to hardbottoms would cost roughly \$23 million, and non construction items \$6 million, making total project cost up to \$35 million, depending on the extent of construction and on the method of disposal (**Table 5**). Potential benefit-to-cost ratios were calculated for each array of traffic assumptions and range from 2.4 to 29.3 (**Table 4**). Based on this information, alternatives to address the planning objectives appear viable.

So if the environmental cost are 6 times the construction cost, how/why would we propose further study (and certainly not by the Corps of Engineers?)

I. ESTABLISHMENT OF A PLAN FORMULATION RATIONALE

The conclusions from the preliminary screening form the basis for the next iteration of the planning steps that would need to be addressed in a feasibility phase. The likely array of alternatives that could be considered in the next iteration includes alternatives 1 and 2 and the combination of alternatives 1 and 3, and 2 and 3. Further exploration of alternative 3 is warranted to conclusively determine whether or not it satisfies planning objectives independently. Future screening and reformulation should be based on the following factors: avoidance, minimization, and mitigation options of environmental resources impacted by the proposed alternatives; ship simulation modeling analysis of the current channel configuration, and optimization of navigational improvements; establishment of economic benefits; and comparison of economic versus environmental impacts.

Table 4: Benefits of Widening Key West Harbor Channel (also Table A-9 in Appendix A)

Potential Benefits of Widening Key West Channel			
\$2010 USD 4.375% Discount Rate			
Estimation Assumptions	Low	Medium	High
SHIPS & CALLS			
New Ships Calling @ Key West	2	3	4
Calls Per Year	24	48	52
PASSENGER IMPACT			
Passengers per Ship	4,000	4,500	5,400
% Disembarking	70%	85%	98%
Total New Passenger-Visitors	134,400	550,800	1,100,736
Spending per Visitor	\$40	\$50	\$55
Economic Impact per Year	\$5,376,000	\$27,540,000	\$60,540,480
CREW & STAFF IMPACT			
Crew & Staff per Ship	1250	1500	2165
% Disembarking	30%	35%	40%
Total New Crew-Visitors	18000	75600	180128
Spending per Crew Member	\$40	\$50	\$62
Economic Impact per Year	\$720,000	\$3,780,000	\$11,167,936
SHIP IMPACT			
Total New Ship Calls	48	144	208
Spending per Call	\$12,000	\$22,500	\$54,000
Key West Net Tax Proceeds	\$264,835	\$1,085,351	\$2,169,000
Economic Impact per Year	\$576,000	\$3,240,000	\$11,232,000
BENEFITS & COSTS			
Total Economic Impact / Year	\$6,672,000	\$34,560,000	\$82,940,416
Losses to Puerto Rico (10%)	(\$667,200)	(\$3,456,000)	(\$8,294,042)
Losses to USVI (20%)	(\$1,334,400)	(\$6,912,000)	(\$16,588,083)
Total Average Annual Benefit	\$4,670,400	\$24,192,000	\$58,058,291
Present Value, Total Benefit	\$94,204,662	\$487,966,595	\$1,171,069,223
Total Cost	\$40,000,000	\$40,000,000	\$40,000,000
Total Average Annual Cost	\$1,983,087	\$1,983,087	\$1,983,087
NET BENEFITS	\$54,200,000	\$447,970,000	\$1,131,070,000
BENEFIT TO COST RATIO	2.36	12.20	29.28
JOBS CREATED			
Full-Time Equivalent Jobs	147	760	1,824

Table 5: Preliminary Estimates of Total First Costs on Each Alternative Plan

Key West Harbor, Florida - Reconnaissance Study. Project number 121755

Option 1 & 2 - North or South ODMDS Disposal

	Alternative 1	Alternative 2	Alternative 3
Construction			
06 Fish and Wildlife Facilities	\$ 22,715,000	\$ 22,715,000	\$ 746,000
12 Navigation Ports & Harbors (DREDGING)	\$ 5,933,000	\$ 5,856,000	\$ 6,144,000
TOTAL Construction Cost	\$ 28,648,000	\$ 28,571,000	\$ 6,890,000
Non-Construction			
01 Lands and Damages	\$ 12,500	\$ 12,500	\$ 12,500
30 Planning, Engineering and Design	\$ 3,677,500	\$ 3,669,500	\$ 1,501,500
31 Construction Management (S&A)	\$ 2,292,000	\$ 2,285,000	\$ 551,000
99 Aids to Navigation	\$ 250,000	\$ 250,000	\$ 250,000
TOTAL Non-Construction Cost	\$ 6,232,000	\$ 6,217,000	\$ 2,315,000
TOTAL COST	\$ 34,880,000	\$ 34,788,000	\$ 9,205,000
Total Durations (Days)	138	136	142

Option 3 - Upland Disposal to Fleming Key Island

	Alternative 1	Alternative 2	Alternative 3
Construction			
06 Fish and Wildlife Facilities	\$ 22,715,000	\$ 22,715,000	\$ 746,000
12 Navigation Ports & Harbors (DREDGING)	\$ 7,455,000	\$ 7,327,000	\$ 7,615,000
TOTAL Construction Cost	\$ 30,170,000	\$ 30,042,000	\$ 8,361,000
Non-Construction			
01 Lands and Damages	\$ 12,500	\$ 12,500	\$ 12,500
30 Planning, Engineering and Design	\$ 3,454,500	\$ 3,441,500	\$ 1,273,500
31 Construction Management (S&A)	\$ 2,414,000	\$ 2,404,000	\$ 669,000
99 Aids to Navigation	\$ 250,000	\$ 250,000	\$ 250,000
TOTAL Non-Construction Cost	\$ 6,131,000	\$ 6,108,000	\$ 2,205,000
TOTAL COST	\$ 36,301,000	\$ 36,150,000	\$ 10,566,000
Total Durations (Days)	163	161	167

Notes:

1. All non-construction cost provided by CESAJ-PD-PN with added Contingency.
2. Ref file :
KWH Recon Alts 2010.mlp
3. Above durations are for construction dredging only and do not include any mitigation time.
4. Effective Date of Pricing July 2010.

6. FEDERAL INTEREST

Providing safe, reliable, and efficient channels and harbors for the movement of commerce, in an environmentally sustainable manner is an output with a high budget priority. Alleviation of channel restrictions is the primary output of the alternatives to be evaluated in a feasibility phase, pending a relief from regulations implemented under Public Law 101-605. According to the Economic and Environmental Principles for Water and Related Land Resources Implementation Studies, paragraph 5(c), “Plans may be formulated which require changes in existing statutes, administrative regulations, and established common law; such required changes are to be identified.” The sponsor indicates a desire to use this analysis as documentation for a request to their Congressional representatives asking for modification of Public Law 101-605, or for a one-time waiver such that channel widening could occur.

Based on the preliminary screening of alternatives, there appears to be potential project alternatives but would incur significant environmental impact. Federal interest in further study of the navigation problems at Key West would have to be sought by the City of Key West by submitting this report and other supporting documentation to the Secretary of the Army for Civil Work, consistent with Army policies, costs, benefits, and environmental impacts. Evaluation of alternative plans during a feasibility study is accomplished using the following four accounts established in the Corps’ Principles and Guidelines to facilitate the evaluation and display of effects of alternative plans (ER 1105-2-100): NED, Environmental Quality (EQ), RED and Other Social Effects (OSE). An overview of each account as it pertains to each alternative is provided below in **Table 6**.

Table 6: The Four Accounts: Description, Effects & Magnitude

The Four Accounts: Description, Effects & Magnitude	
Effect & Magnitude	Account & Description
<p>Positive +++++</p>	<p>National Economic Development (NED) This account displays changes in the economic value of the national output of goods and services. This account is best measured by net benefits. For this project net benefits are expected to be positive and very large. Net benefits could be in the order of magnitude of hundreds of millions of dollars.</p>
<p>Negative (add more dashes)</p>	<p>Environmental Quality (EQ) This account displays non-monetary effects on ecological and environmental resources including both the positive and adverse effects of Federal plans. This project is anticipated to have a significant negative effect on environmental quality. Widening the channel would have significant and negative effects on an unspecified amount of coral lightly distributed over approximately 17 acres. The project would also have negative effects on an unspecified amount of critical environmental habitat. Increased cruise traffic, as with an increase in any waterborne commerce, would likely also cause an increase in water pollution and turbidity. However, the increased tax revenues caused by the projects could also be used to mitigate these or other negative environmental impacts. (delete or move to the section above) Add Legal impediments would have to be overcome.</p>
<p>Positive +++++</p>	<p>Regional Economic Development (RED) This account displays changes in the distribution of regional economic activity (e.g., income and employment). This account would vary similar to the NED account: positive, potentially with increased employment and income in the region. It may also cause some loss of regional income in the U.S. Virgin Islands and Puerto Rico, though this is not certain to happen (as discussed previously in this appendix).</p>
<p>Unknown +/-</p>	<p>Other Social Effects (OSE) This account displays plan effects on social aspects such as community impacts, health and safety, displacement, energy conservation, culture, aesthetics and others. This project is expected to have positive and negative OSE impacts. Positive effects could include increased community cohesion if increased economic activities allow a more stable local economy. Increased urban congestion, pollution, and noise could be expected to accompany additional tourists.</p>

7. PRELIMINARY FINANCIAL ANALYSIS

As the local sponsor, the City of Key West will be required to provide 50 percent of the cost of the feasibility phase. The local sponsor is also aware of the cost sharing requirements for potential project implementation.

8. ASSUMPTIONS AND EXCEPTIONS

Feasibility Phase Assumptions: The following critical assumptions will provide a basis for the feasibility study:

- (1) Without a Federal channel widening project it is anticipated that no channel widening will occur. Due to significant environmental constraints it would be impossible for the city, county or state to construct their own widening project without Federal participation. An act of Congress would be required to modify existing environmental constraints surrounding the channel.
- (2) Without the project, all of the expenditures generated by the newer, larger cruise ship vessels that would otherwise accrue to the Key West economy would instead begin accruing to Cozumel Mexico, Freeport Bahamas, Kingston Jamaica, and the like, almost exclusively outside of the U.S.⁴.
- (3) Section 230 WRDA 1996 clarified that when cruise ships are part of a Corps navigation study, all benefits generated by cruise ships are to be counted as commercial navigation benefits, rather than recreation benefits (i.e. these benefits are to be counted as primary benefits, can be formulated for, and are not constrained to 50% of justifying benefits). Benefits of navigation improvements affecting cruise ships arise from more efficient ship operations and increased tourism or enhanced tourism experience. Prior to the 1996 WRDA efficiency improvement was classified as commercial navigation and improved tourism was classified as recreation. Categorization of benefits matters because the Corps considers commercial navigation one of its high priority missions (PGL 97-6, **Attachment 2**).

⁴ The US territories of Puerto Rico and the US Virgin Islands also accrue benefits from Cruise Shipping and there likely would be somewhat of a substitution effect, proportional to these territories' relatively small role in the overall Caribbean cruise industry.

(4) The Key West cruise ship benefits are included as NED benefits, not RED benefits. This methodology is supported by the fact that Key West is a port of call competing with other international ports as opposed to regional U.S. ports.

(5. Economic benefits should be calculated per IWR Report 99-R-8 “The US Cruise Industry Evaluation of National Economic Development Benefits”, which provides descriptions of benefits to cruise vessels including:

- Decreases in vessel operating costs
- Increases in producer surplus (net revenues, profits)
- Benefits to passengers (increase in the value of passenger experience or reductions in passenger opportunity costs of time and out-of-pocket expenses).

9. FEASIBILITY PHASE MILESTONES

Milestone 1 – Reconnaissance Report Certified	TBD
Milestone 2 – FCSA signed	TBD
Milestone 3 – Receipt of Funds/Initiate Study	2 months
Milestone 4 – Initial Scoping Meeting	5 months
Milestone 5 – Feasibility Scoping Meeting	6 months
Milestone 6 – Complete Preliminary Alternative Analysis	8 months
Milestone 7 – Complete Alternative Formulation Briefing	6 months
Milestone 8 – Complete Draft Report	5 months
Milestone 9 – Initiate Coordination of Draft Report	5 months
Milestone 10 – Complete Final Report	7 months
Milestone 11 – Civil Works Review Board	5 months
Milestone 12 – Chief's Report/Final Report Approved	10 months*

* It is estimated that from receipt of funds to the Chief’s Report final approval of the Feasibility Study, it will take approximately five years.

10. FEASIBILITY PHASE COST ESTIMATE

Costs	Activities
\$1,250,000	Surveys and Mapping
\$650,000	Hydrology and Hydraulics Studies/Reports
\$180,000	Geotechnical Studies/Reports
\$250,000	Engineering and Design Analysis Report
\$425,000	Socioeconomic Studies
\$35,000	Real Estate Analysis Report
\$430,000	Environmental Studies/Report
\$25,000	Fish and Wildlife Coordination Act Report
\$15,000	HTRW Studies/Report
\$235,000	Cultural Resource Studies/Reports
\$30,000	Cost Estimates
\$130,000	Public Involvement Documents and Meetings
\$275,000	Plan Formulation and Evaluation
\$50,000	Draft Report Documentation
\$120,000	Final Report Documentation
\$50,500	Value Engineering Documentation
\$145,000	Technical Review Documents
\$50,000	Washington Level Report Approval
\$250,000	Independent External Peer Review
\$150,000	Project Management and Budget Documents
\$10,000	Supervision and Administration
\$713,000	Contingencies
\$5,000	Project Management Plan (PMP)
\$5,000	PED Cost Sharing Agreement
\$5,480,000	Estimated Total

11. POTENTIAL ISSUES AFFECTING INITIATION OF FEASIBILITY PHASE

a. Congressional action is needed prior to any construction activity within the boundaries of the Florida Keys National Marine Sanctuary. Until this issue is resolved there is little benefit in proceeding with the feasibility phase.

12. RECOMMENDATIONS

This report recommends The City of Key West facilitate a meeting with State and Federal resource agencies to request a one-time waiver to Public Law 101-605 (Florida Keys National Marine Sanctuary and Protection Act) such that channel widening could be accomplished. Such a waiver would still require Congressional action or approval. If discussions with the resource agencies result in the inability to come to an agreement about relief from current regulations, further analyses of channel design alternatives, which do not include channel widening, are warranted. It is likely that the Corps would be restricted from entering into a Feasibility Study with the current proposed channel widening recommended plan design until relief from regulations implemented under Public Law 101-605 has been granted.



Keiser

THE CITY OF KEY WEST

Post Office Box 1409 Key West, FL 33041-1409 (305) 809-3700

July 24, 2008

Mr. Jerry Scarborough, P.E.
Coastal/Navigation & Antilles Branch Chief
Jacksonville District
United States Army Corps of Engineers
701 San Marco Boulevard
Jacksonville, FL 32207
United States of America

**RE: Key West Federal Harbor Project
Request for Initiation of Reconnaissance Study**

Dear Mr. Scarborough,

The City of Key West is responsible for managing the Port of Key West. As such, we have become increasingly aware of significant channel constraints in the Key West Federal Project. Letters from the Key West Harbor Pilots (see attached) have identified navigational safety issues as well as limits which we believe are impacting the economy of the United States.

The United States House of Representatives Committee on Transportation and Infrastructure passed a resolution (Docket 2777) directing the Secretary of the Army to determine whether modifications to the channel are warranted (see attached). As a first step in the study process, the City of Key requests that the Jacksonville District initiate a Reconnaissance Study. We understand that federal funding for the study is necessary, and we are working with our congressional delegation and federal partners to secure the \$100,000 necessary to conduct the study. The City is hopeful that funding will be available by the beginning of the 2008-2009 fiscal year.

The City of Key West and port community stand ready to assist the United States Army Corps of Engineers in the federal investigation of the channel. Please do not hesitate to contact me regarding the next steps to ensure that channel constraints are studied and resolved.

Sincerely,

A handwritten signature in black ink, appearing to read "Ray Archer".

Raymond Archer
Director
City of Key West Port Operations

Xc: Jim Scholl
Amy Kimball-Murley

KEY WEST BAR PILOTS ASSOCIATION

PO BOX 848
KEY WEST, FL 33041
305 296-5512
FAX 305 296-1388
keywestbarpilots@bellsouth.net

November 13, 2007

Mr. Raymond Archer
Port Director
City of Key West
525 Angela Street
Key West, FL 33040

Dear Mr. Archer,

The Port of Key West has been a vibrant and active seaport for well over 150 years, providing an economic engine for the City of Key West. In the last 30 years, for example, we have seen an upward trend in the passenger ship business into Key West. The most recent 2 years, however, have seen a marked decline in passenger ship port calls with further reductions forecasted. This decline is due in no small part to the recent Royal Caribbean (RC) trend of building larger passenger vessels for use in the U.S. cruise market. The size of these newer vessels precludes them from entering the Port of Key West under certain adverse wind and current conditions due to existing ship channel constraints. The 4 state and federally licensed harbor Pilots that comprise the Key West Bar Pilots Association (KWBPA) have therefore concluded that transits of these larger vessels, such as the RC *Voyager* and *Freedom of the Seas* class ships, cannot be conducted on a routine, repeatable basis.

We have recently learned that Carnival, Disney, and Celebrity Cruise Lines are also trending toward larger vessels. Changes must be made to the Key West main ship channel to facilitate the new and larger fleets our customers are building. To do nothing will result in the continued decline in passenger vessel arrivals and place us at a competitive disadvantage with other ports in the Caribbean that can accommodate larger vessels, including the future market forces that will be presented when Cuba opens.

In order to keep pace with an ever changing industry, KWBPA makes the following recommendations for ship channel improvements:

1. Widen Cut "B" 150 ft from 300 ft wide to 450 ft wide. Insure the new width is dredged to the same standards as the recent Navy dredging project (34 ft plus 2 ft maintenance dredging, totaling 36ft deep).

Option 1: Widen 75 ft westward from buoy 9 to buoy 17 and 75 ft eastward from buoy 12 to buoy 14. Retain and adjust existing wideners at buoys 12 and 14 eastward 75 ft. The existing Cut B range lights are located on Sunset Key and mark the centerline of the current Cut B channel. Widening 75 ft on each side would avoid moving the ranges to accommodate a new centerline and also avoid reopening legal land use issues between Sunset Key and the US Coast Guard that have already been resolved. This option would also increase the south turning basin width by 75 ft thus providing additional room for turning larger vessels, particularly when the outer Navy Mole Pier is occupied.

Option 2: Widen 150 ft eastward from buoy 12 to buoy 14. Retain and adjust existing wideners at buoys 12 and 14 eastward 150 ft. Existing Cut B range lights would have to be moved or new range lights constructed to accommodate the new Cut B centerline. This option minimizes the area to be dredged.

2. Construct an outbound range for Cut "B" channel. A sector light would be most economical.
3. Add a channel widener in the vicinity of buoy #7 dredged to 36ft.

4. Remove the defunct light tower base located close NE of buoy #6. This obstruction is the remains of the former light tower #3 that was struck and destroyed by an unpowered tug and barge in 1994. Depths over this man-made obstruction are only 15 ft. This obstruction is a hazard to navigation because of its close proximity to the edge of the ship channel.

5. Move sea buoy KW 0.3 nm south of current position.

6. Depth survey and dredge as necessary Mallory Dock, Westin Pier B, and the Navy Mole Pier to accommodate intended vessels. Schedule periodic channel and dock surveys. Maintenance dredge as necessary.

Certain buoy locations will have to be adjusted to accommodate channel modifications. Other buoys may have to be adjusted or possibly added once an experience factor is gained.

It is our opinion that the Navy should be an interested and cooperative partner in this endeavor as they too have had to turn away larger vessels due to channel constraints.

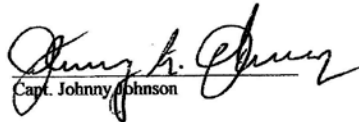
We understand that the changes noted above require the assistance of various County, State and Federal agencies. Please feel free to distribute this letter as you see fit to any concerned parties. We will be doing the same. We look forward to working with you, the City of Key West and all the other agencies which will be involved. Time is a consideration as we are already losing market share and stand to lose much more in the near future. If you or anyone else involved in these channel improvements have any questions or comments please feel free to contact us.

Sincerely,


Capt. Michael McGraw


Capt. Robert Fitzsimmons


Capt. Robert Maguire


Capt. Johnny Johnson

Planning Guidance Letter #97-06

Cruise Ships and Benefits to Navigation

CECW-PD (7 July 1997)

MEMORANDUM FOR MAJOR SUBORDINATE COMMANDS AND DISTRICT COMMANDS

SUBJECT: Planning Guidance Letter No. 97-6, Cruise Ships and Benefits to Navigation

1. Purpose. This letter provides implementing guidance for Section 230 (Benefits to Navigation) of the Water Resources Development Act (WRDA) of 1996. This guidance will be incorporated into the revision of ER 1105-2-100, Guidance for Conducting Civil Works Planning Studies.

2. Background. The WRDA of 1996 directs the U.S. Army Corps of Engineers to categorize all benefits generated by cruise ships as commercial navigation benefits. Benefits of navigation improvements affecting cruise ships arise from more efficient ship operations and increased tourism or enhanced tourism experience. Prior to the 1996 WRDA efficiency improvement was classified as commercial navigation and improved tourism was classified as recreation. Categorization of benefits matters because the Corps considers commercial navigation one of its high priority missions.

3. Guidance. Consistent with section 230, feasibility studies should consider economic benefits generated by cruise ships as commercial navigation benefits for project justification and cost sharing purposes.

4. Discussion. Cruise ships that operate out of existing Federal channels and harbors will receive equal consideration with other commercial navigation vessels for Federal harbor or channel improvements. Likewise, where new channels are required for cruise ships they will be treated like other new channel decisions for other commercial navigation vessels. That is, when new channels or harbors are constructed by non-Federal interests, Federal assumption of navigation maintenance may occur consistent with Section 204(f) of WRDA 1986 (as amended by Section 303(b)(1) of WRDA 1990), if approved by the Secretary of the Army for Federal assumption of maintenance prior to construction

FOR THE COMMANDER:

(Signed) RUSSELL L. FUHRMAN, Major General, USA, Director of Civil Works

Appendix A

Economics

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A.1 Existing Conditions

Key West is a Florida city of just over 25,000 people (2000 Census) near the southernmost tip of the United States mainland. The city's main industry is tourism and recreation, though a large U.S. Navy presence is important economically. Historically the city has received considerable economic benefit from visiting cruise vessels. Cruise ship visits are an important source of jobs and income for local residents. Docking fees and tax revenues are a significant source of revenue for the municipal government. As of 2005, the cruise ship industry in Key West was responsible for \$68.7 million dollars of direct economic activity, 1,260 local jobs¹, and approximately 15% of the City's annual tax revenue².

Widening of the Key West Harbor Channel would benefit the cruise ship industry and businesses that support that industry in Key West. The vast majority of large ships calling at Key West are commercial cruise ships. The local population is relatively small, and Key West is connected to South Florida via the Overseas Highway. Hence, other than cruise ships, there is limited shipping at Key West Harbor.

Cruise ship calls to Key West have significantly declined in recent years. Cruise companies have built increasingly large vessels to take advantage of economies-of-scale in providing services to passengers. The latest three generations of cruise ships (Voyager, Freedom and Oasis classes: 138,000 tons, 154,410 tons, and 225,282 tons, respectively) have been unable to call at Key West because the ships are too large to operate safely within the channel. This has resulted in a severe decrease in the number of ships and passengers calling at Key West, resulting in a significant loss of employment, income, and tax revenue.

Meanwhile, cruising in the overall Caribbean market has continued to expand rapidly, despite a variety of economic shocks and recessions. Since 1990, the industry has had an average annual passenger growth rate of 7.4% per annum³. Hence, Key West's losses are a transfer of national wealth to Cozumel, Mexico; Freeport, Bahamas; Kingston, Jamaica; and other ports, almost exclusively outside of the United States. Widening the channel in Key West would allow newer generations of larger cruise ships to call at Key West, and would have a highly significant effect on economic development.

Table A-1 shows overnight and day-trip visitors to Key West steadily increasing since 2005, while cruise passenger numbers have decreased by over 30% in the same timeframe. The point is emphasized by the fact that cruising is one of the most economical vacation alternatives available; and that cruising in the Caribbean overall has continued to increase or at least stay steady despite a number of economic shocks and recessions over the past 20 years (see CLIA, 2008).

¹ F-CCA, *Economic Impact of Cruise Tourism on the Caribbean Economy*, 2006

² *The Impact of the Cruise Ship Industry on the Quality of Life in Key West*, Thomas J. Murray & Associates, Inc., 2005

³ CLIA, *The Overview*, 2009

Table A-1: Key West Visitor Person-Trip Estimates

Key West Visitor Person-Trip Estimates				
Year	Overnight Visitors	Day Trippers	Cruise Passengers	Total Visitors
2003	1,309,559	242,268	1,067,222	2,619,049
2004	1,303,633	241,172	934,070	2,478,875
2005	1,046,111	237,460	925,795	2,209,366
2006	1,063,752	196,794	888,183	2,148,729
2007	1,094,647	202,510	816,919	2,114,076
2008	1,112,978	205,901	739,218	2,058,097

Source: Monroe County Tourist Development Council; Smith Travel Research

A.1.1 Economic Impacts of Cruise Shipping in Key West

Table A-2 below shows Key West’s economic impact relative to other Caribbean ports of call. Key West’s \$69 million dollars of cruise tourism expenditures represented 3.9% of the overall Caribbean market during the 2005-2006 cruise season. The U.S. territories of San Juan, Puerto Rico and the U.S. Virgin Islands represented 9.6% and 20.4% of total expenditures, respectively.

Table A-2: Economic Contribution of Cruise Tourism by Destination, 2005-2006

Economic Contribution of Cruise Tourism by Destination, 2005-2006			
	Total Cruise Tourism Expenditures (\$M)	Expenditures as a % of Total	Total Employment
Antigua	\$41	2.3%	1,215
Aruba	\$66	3.7%	1,710
Bahamas	\$144	8.2%	3,965
Barbados	\$57	3.2%	1,635
Belize	\$64	3.6%	1,885
Cayman Islands	\$180	10.1%	3,705
Cartagena	\$5	0.3%	140
Costa Maya	\$60	3.4%	1,770
Cozumel	\$214	12.1%	5,945
Curacao	\$18	1.0%	420
Dominica	\$14	0.8%	390
Grenada	\$16	0.9%	485
Key West	\$69	3.9%	1,260
Martinique	\$4	0.2%	115
San Juan	\$170	9.6%	3,865
St. Kitts	\$7	0.4%	205
St. Lucia	\$35	2.0%	1,035
St. Maarten	\$246	13.9%	5,590
U.S.V.I.	\$362	20.4%	6,165
All Destinations	\$1,772	100.0%	41,500

Source: Florida-Caribbean Cruise Association, *Economic Impact of Cruise Tourism*, 2006 & USACE SAI

Table A-3 below shows an estimate of the economic impacts of tourism and cruise ship expenditures in Key West for 2004. It shows that cruise tourism is responsible for \$88 million dollars of economic activity and 955 jobs. This accounts for 7.8% of overall tourism economic impact in Key West (due to varying sources of data and varying years for which they are estimated there may be discrepancies between economic impact estimates).

Table A-3: Economic Impacts of Tourism & Cruise Ship Expenditures in Key West, 2004

Economic Impacts of Tourism & Cruise Ship Expenditures in Key West, 2004			
All Tourism	Direct	Indirect	Total
Output	\$714,970,282	\$426,228,614	\$1,141,198,896
Employment	8,114	4,162	12,276
Cruise Ship Tourism			
Output	\$55,622,944	\$33,159,546	\$88,782,490
Employment	631	324	955

Source: The Impacts of the Cruise Ship Industry on the Quality of Life in Key West, Thomas J. Murray & Associates, Inc. 2005

A.1.2 Tax Revenue Impacts of Cruise Shipping in Key West

Cruise ships are an important source of tax revenue for the city of Key West. Revenue derived from cruise operations account for approximately 15% of total city revenues (**Table A-4**). Cruise-related city operations only account for approximately 7.5% of city expenditures. Thus cruising is a revenue-positive activity for the city, generating 1.5 times more revenue than is expended.

Table A-4: Tax Revenues from Cruise Ships for the City of Key West, FY03-04

Tax Revenues from Cruise Ships for the City of Key West		
	FY03-04	%
Total KW Tax Revenue	\$31,288,802	100%
Cruise Ship KW Tax Revenue	\$4,541,897	15%

Source: The Impacts of the Cruise Ship Industry on the Quality of Life in Key West, Thomas J. Murray & Associates, Inc. 2005 & the City of Key West

A.1.3 Demand for Cruise Ship Calls at Key West

It is possible that cruise traffic has declined in Key West for reasons unrelated to the vessel restriction on cruise ships. This section explores factors that contribute to demand for cruise ship calls at Key West. It concludes that Key West is still a desirable port of call, and that the recent decline in cruise traffic was caused by vessel restrictions, a decline that a Federal channel widening project could reverse.

Demand for cruise calls is ultimately determined by cruise passengers. Cruise companies cater to the likes and dislikes of their customers when planning itineraries. Passengers report being generally very satisfied with Key West as a port of call. Approval ratings for Key West among Cruise Ship passengers are close to 90%. **Table A-5** shows results of a passenger survey completed by the Florida-Caribbean Cruise Association. Key West scored an average of 7.4 out of a possible 10.

Another factor that determines desirability of ports for cruise companies is the per-passenger cost of calling there. Ports generally assess a head tax or disembarking passenger tax on calling cruise vessels. This tax ranges from \$3.50 per passenger in Cozumel, Aruba & Curacao, to \$15 per passenger in the Bahamas and Jamaica. Key West does not have a single head tax. The per-passenger fees or taxes charged in Key West vary depending on which pier the ship docks at; from \$2.50 per passenger to \$10.84 per passenger. On average cruise ships pay \$5.63 per passenger. This is very competitive with most other ports of call (**Table A-6**).

Amenities offered at a location are also important to cruise itinerary planners. Itinerary planners seek to offer the maximum number and variety of well-liked ports-of-call. Customers demand quantity, variety, and value. Itinerary planners are also employed to minimize vessel operation costs. The largest two expenses for cruise operations are the costs of fuel and the crew. These are minimized via a variety of methods, but are in large part driven by time and distance. Thus an itinerary which can offer a variety of well-liked ports over a shorter distance and time, is often more desirable than those over a longer distance and time. Key West's relatively close proximity to South Florida makes it very desirable in this regard (the majority of Caribbean cruises depart out of one of the three South Florida ports; Miami, Port Everglades, and Canaveral). See **Figure A-1** for a map of the Caribbean with Key West's location highlighted.

Prior to certain class vessels becoming too large to traverse Key West's channel, the city had a long history of voluminous cruise traffic. The decline in cruise traffic corresponds almost exactly with the advent of vessels that have proportions too large to call at Key West.

Key West's port is well-liked, affordable, convenient, and has a history of success. It is reasonable to conclude that Key West remains a desirable port of call for cruise companies, and that the decline in traffic is in fact caused by channel restrictions. A number of interviews with well-informed stakeholders have confirmed this conclusion anecdotally.

Table A-5: Key West Passenger Satisfaction Survey Results

Key West Passenger Satisfaction Survey Results	
Satisfaction Categories	Mean Score
Initial Shoreside Welcome	7.6
Guided Tour	8.3
Shopping Experience	7.4
Historic Sites/Museums	7.7
Beaches	6.3
Friendliness of Residents	7.7
Courtesy of Employees	8.1
Variety of Shops	7.7
Overall Prices	6.7
Taxis/Local Transportation	7.1
Feeling of Safety Ashore	8.9
Visit Met Expectations	7.7
Likelihood of Recommending Resort Vacation	7.0
Likelihood of Return for Resort Vacation	5.5
Source: F-CCA, <i>Economic Impact of Cruise Tourism, 2006</i>	

Table A-6: Head Taxes at Caribbean Cruise Ports

Caribbean Cruise Port Head Taxes	
Port	Head Tax
Antigua	\$7.50
Aruba	\$3.50
Bahamas	\$15.00
Barbados	\$6.00
Belize	\$7.00
Cayman Islands	\$14.04
Cartagena	\$7.60
Curacao	\$3.50
Dominica	\$6.50
Grenada	\$4.50
Jamaica	\$15.00
Cozumel	\$3.50
Puerto Rico	\$13.25
St Kitts	\$6.50
St Lucia	\$6.50
St Maarten	\$5.50
Average	\$7.84
Key West	\$2.50-\$10.84
KW Average	\$5.63
Source: RCCL & City of Key West	

Figure A-1: Map of Caribbean



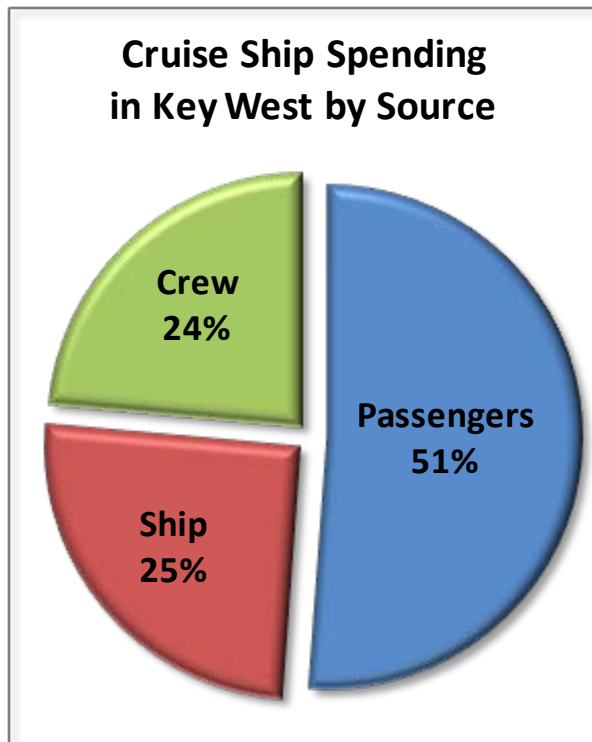
Table A-7: Key West's Competing Ports of Call

Key West Competing Ports of Call			
Port or City	Country	Port or City	Country
St. John's	Antigua & Barbuda	Montego Bay	Jamaica
Oranjestad	Aruba	Ocho Rios	Jamaica
Nassau	Bahamas	Fort-de-France	Martinique
Freeport	Bahamas	Costa Maya	Mexico
Bridgetown	Barbados	Cozamel	Mexico
Belize City	Belize	Curacao	Netherlands Antilles
Tortola	British Virgin Islands	Charlestown	Nevis
Virgin Gorda	British Virgin Islands	Colon	Panama
Jost Van Dyke	British Virgin Islands	San Juan	Puerto Rico
Anegada	British Virgin Islands	Philipsburg	Sint Maarten (Dutch)
Puerto Limon	Costa Rica	Gustavia	St. Barts
Roseau	Dominica	Basseterre	St. Kitts
Santo Domingo	Dominican Republic	Castries	St. Lucia
George Town	Grand Caymans	Marigot	St. Martin (French)
St. George	Grenada	Grand Turk	Turks & Caicos
Labadee	Haiti	Key West	United States
Roatan	Honduras	St. Croix	US Virgin Islands
Kingston	Jamaica	St. John	US Virgin Islands
Falmouth	Jamaica	St. Thomas	US Virgin Islands

A.1.4 Cruise Ship Spending

Figure A-2 shows cruise ship spending in Key West by source. More than half of total spending is by passengers (51%). Passengers typically spend in the retail service sector: food and drink, clothing and accessories, jewelry, etc. The crew and staff of the ship are a smaller population and disembark at lower rates than passengers, but sometimes spend more per-person per-trip than passengers. The spending patterns of crew and staff are more domestic: personal items, household goods, and bulk foods. Their spending accounts for approximately 24% of total cruise ship spending. The ship itself accounts for approximately 25% of total spending. Cruise companies have found it more cost-effective to purchase stores, supplies, fuels and other necessities along their route rather than depart fully stocked.

Figure A-2: Cruise Ship Spending in Key West by Source



Source: The Impacts of the Cruise Ship Industry on the Quality of Life in Key West, Thomas J. Murray & Associates, Inc. 2005

Estimates for passenger and crew/staff spending per visit vary widely depending on the source and date. Estimates for passenger spending vary between \$32 and \$138 per visit. Estimates for crew/staff spending vary much less and are generally in the range of \$40 to \$70 per visit.

A.2 Future Without Project Conditions

Without a Federal channel widening project it is anticipated that no channel widening will occur. Due to significant environmental constraints it would be impossible for the city, county, or state to construct their own widening project without Federal participation. An act of congress is required to modify existing environmental constraints surrounding the channel. Therefore, it is extremely unlikely that any non-federal channel widening project will be constructed.

Without a widening of the channel it is anticipated that current trends will continue. Larger ships will continue to replace the smaller, older ships in the Caribbean. This will result in continued loss of cruise ship traffic in Key West. Meanwhile, the Caribbean cruise industry will continue to grow. The calls that Key West loses will be replaced by calls in the Bahamas, Jamaica, Mexico and a variety of other, almost entirely foreign, ports. This will result in a significant NED loss.

A.2.1 Trends in Cruise Shipping

Royal Caribbean Cruises Ltd. (RCCL) and Carnival Corporation (CCL) represent the largest number of cruise lines that visit Key West. Over 90% of ships that visit Key West are from these two cruise ship companies.⁴ Royal Caribbean made some of its fleet statistics available for use in this study. The Royal Caribbean fleet can easily be used as a proxy for all Caribbean cruise vessels as the other fleets are very similar and follow similar trends.

Table A-8, Figure A-4, Figure A-5 and Figure A-6 all compare ships calling at Key West to ships in the Royal Caribbean (RC) fleet. As can be seen on these tables and figures, the RC fleet continues to grow in average length and tonnage while Key West Harbor capacity remains stagnant and traffic decreases. Gross tonnage is the industry standard method of measuring the overall volume of a vessel, accounting for length, width and height of vessels. **Figure A-3** shows the growth in gross tonnage of the world fleet of cruise vessels by year built and compares it to the largest tonnage of ship ever to call at Key West⁵. The RC Freedom Class for example, is currently restricted from calling at Key West due to channel constraints and has a gross tonnage of 160,000.

⁴ Murray et al, *The Impacts of the Cruise Ship Industry on the Quality of Life in Key West, 2005*

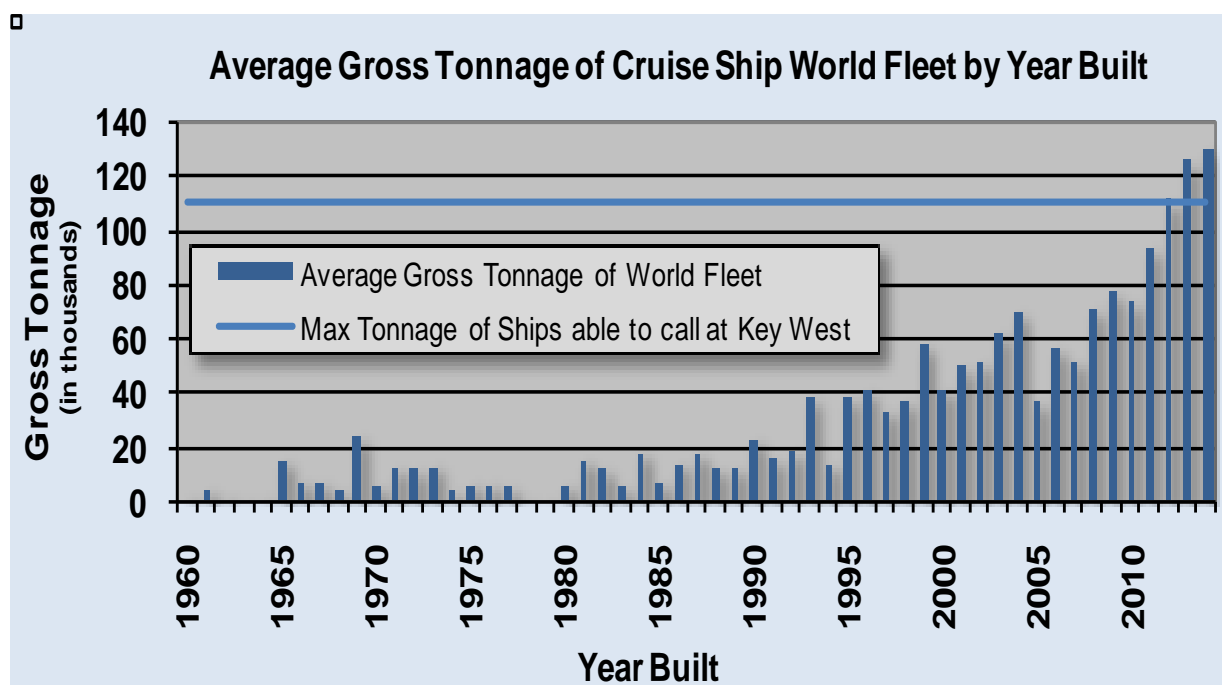
⁵ City of Key West vessel log data, provided directly from city employees, Port Operations division, 2010

Table A-8: Recent History of Cruise Ships in Key West & Royal Caribbean Fleet Statistics

Recent History of Cruise Ships in Key West			Royal Caribbean Fleet Statistics	
Year	Passengers	Ships	Average Length	Average Tonnage
2002	1,020,024	539	872	81,011
2003	1,057,632	562	881	83,431
2004	955,912	484	884	83,669
2005	930,706	465	884	83,669
2006	928,080	425	892	86,108
2007	812,792	396	899	88,385
2008	727,407	337	910	91,376
2009	805,433	344	922	95,945

Data provided by City of Key West, 2010 | Data provided by Royal Caribbean Cruise Lines, 2010

Figure A-3: Average Gross Tonnage of Cruise Ship World Fleet by Year Built



Source: Lloyds' Register of Ships, Sea-Web World Fleet data, accessed January 2010, www.sea-web.com

The average gross tonnage of the world fleet however, when compared to the unique Caribbean market, is extremely underestimated. The Caribbean represents the elite cruise ship market and is fueled by competition for on-board facility uniqueness. This niche has long been, and continues to be, the largest and most prestigious market for cruise ships. As cruise companies build ever-larger, newer and better flagship vessels, they deploy them into the Caribbean. To avoid flooding the Caribbean market with an over-supply of available berths the cruise companies move their older, smaller ships from the Caribbean to developing markets in China, India and the Baltic Sea⁶. This allows them to simultaneously grow their business and operate their newer

⁶ Cruise Shipping Miami Conference, Vessel Deployment Segment, 2010

ships in the Caribbean without detrimentally reducing prices or under employing older vessels. Because of this pattern of fleet deployment, the Caribbean is constantly on the leading edge of the world's largest, biggest and newest ships. Thus average gross tonnage of ships operating in the Caribbean is actually much higher than the average size of the world fleet.

The figures on the following page compare the length, tonnage, and maximum passenger capacity of ships able to call at Key West to that of the Royal Caribbean fleet (which serves as a proxy for all ships operating in the Caribbean). The figures clearly show how the last three generations of RC cruise ships have exceeded Key West's vessel size thresholds due to channel constraints.

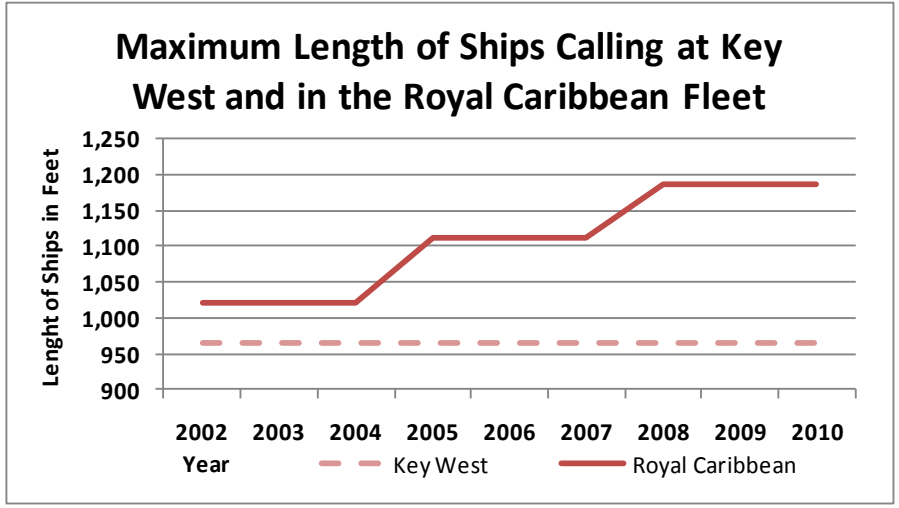


Figure A-4: Maximum Length of Ships Calling at Key West and in the Royal Caribbean Fleet

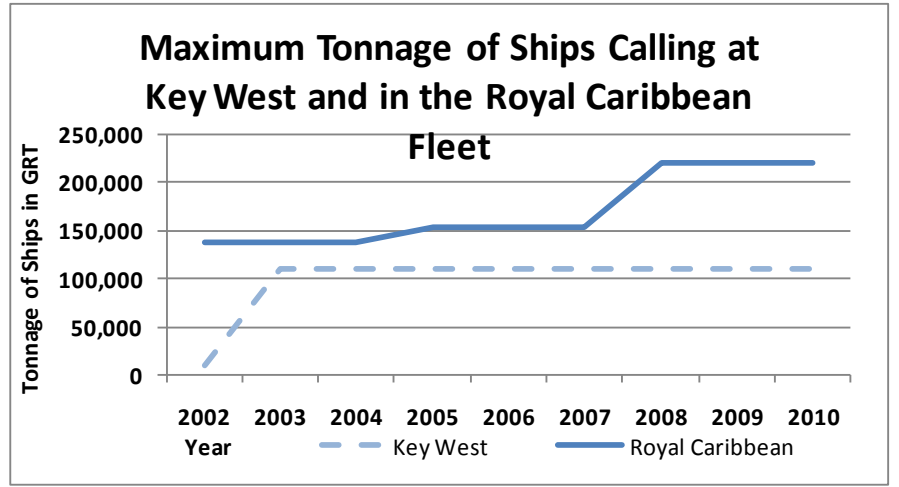


Figure A-5: Maximum Tonnage of Ships Calling at Key West & in the Royal Caribbean Fleet

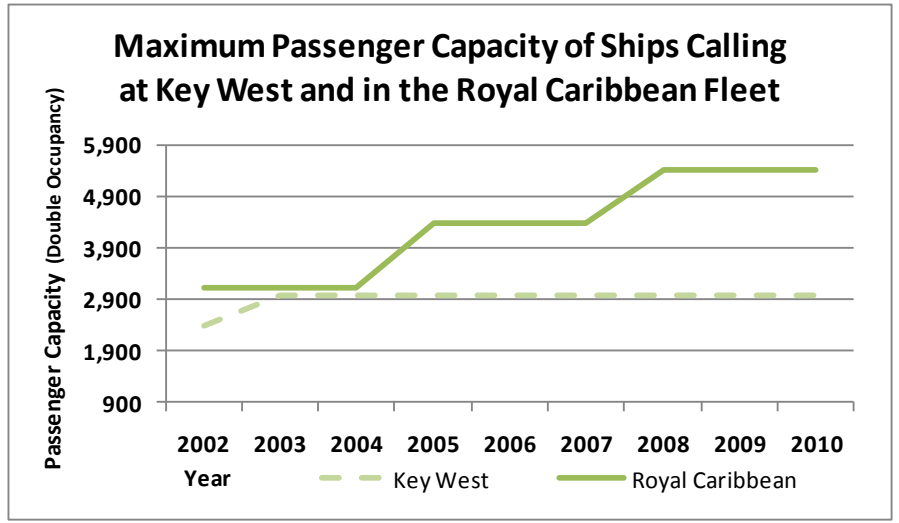


Figure A-6: Maximum Passenger Capacity of Ships Calling at Key West and in the Royal Caribbean Fleet

A.3 Future With Project Conditions

Future with project conditions involving channel widening would likely reverse patterns of cruise ship traffic declines. Cruise ship traffic in Key West Harbor is anticipated to almost immediately return to pre-constrained levels. Furthermore, traffic would likely increase beyond pre-constraint levels as pent-up demand for calls at Key West Harbor could then be fully met. From that point forward it is anticipated that cruise traffic in Key West would increase proportionally to overall increases in Caribbean cruise traffic (~7% per year, CLIA). The estimated benefits in this report are very conservative in that they assume a certain amount of cruise traffic returning and then no subsequent growth.

A.4 Costs of Widening Key West Channel

The greatest portion of costs for channel widening is the environmental costs. The costs for mitigation of anticipated hardbottom impacts and other environmental considerations are triple the costs of the actual dredging and disposal. It is estimated that dredging and disposal would cost roughly \$5 to \$6 million, environmental considerations and potential impacts to hardbottoms would cost roughly \$23 million, and non construction items \$6 million, making total project cost up to \$35 million, depending on the extent of construction and on the method of disposal.

A.5 Benefits of Widening Key West Channel

This study evaluates alternatives for widening the channel to facilitate return of the lost commerce. If realized, the income, docking fees, and increased tax revenues will represent increases in NED because economic activity will return to the U.S. from foreign competitors.

In addition to benefits from returned cruise traffic, a federal channel widening project may have a number of other benefits as well. Among them are: consumer surplus, producer surplus, and increased public safety.

Estimates of potential benefits from a federal channel widening project can be seen on **Table A-9**. The estimates employ an array of parameter and forecast assumptions ranging from low to high. Depending on the assumptions used, benefits range from \$4.6 million dollars average annual benefit to \$58 million dollars average annual benefit. It is not appropriate to calculate an exact benefit-to-cost ratio for a reconnaissance report. However, for informational purposes an array of potential benefit-to-cost ratios has been estimated for each of the four assumptions, and range from 2.4 to 29.3.

A.5.1 Legislation & Guidance on Cruise Benefits

Section 230 WRDA 1996 clarified that when cruise ships are part of a Corps navigation study, all benefits generated by cruise ships are to be counted as commercial navigation benefits, rather than recreation benefits (i.e. these benefits are to be counted as primary benefits, can be formulated for, and are not constrained to 50% of justifying benefits).

The WRDA of 1996 directs the U.S. Army Corps of Engineers to categorize all benefits generated by cruise ships as commercial navigation benefits. Benefits of navigation improvements affecting cruise ships arise from more efficient ship operations and increased tourism or enhanced tourism experience. Prior to the 1996 WRDA efficiency improvement was classified as commercial navigation and improved tourism was classified as recreation. Categorization of benefits matters because the Corps considers commercial navigation one of its high priority missions. (PGM 97-6)

The authors of this report have no knowledge of a precedent for counting benefits from induced cruise traffic as NED benefits. However, this methodology has been briefed to the SAD and HQ vertical team who agreed that it is a valid and appropriate method of estimating benefits for this project (refer to Section A.5.2.4 for more information).

IWR Report 99-R-8 “The U.S. Cruise Industry Evaluation of National Economic Development Benefits” provides descriptions of benefits to cruise vessels which include:

- Decreases in vessel operating costs
- Increases in producer surplus (net revenues, profits)
- Benefits to passengers (increase in the value of passenger experience or reductions in passenger opportunity costs of time and out-of-pocket expenses).

These and other benefits are addressed in this appendix.

A.5.2 Potential NED Benefits for Key West Channel Widening

- Producer Surplus (operational savings and profits to cruise ships)
 - Speed adjustments and fuel savings
(not really an issue, real savings are for open seas travel, not channel travel)
 - Less lost time waiting on conditions
(very minor;<5 calls per year)
 - Less tug assist expense
(extremely minor; tugs are almost never used, especially with the newer ships)
 - Economies of scale (larger ships → lower per capita costs)
- Consumer Surplus (savings or benefits to cruise ship passengers)
 - Lower cost for same experience → consumer surplus
 - Same cost for better experience → consumer surplus
(As of WRDA 2007, benefits from cruise ship passengers can contribute towards benefits in a navigation project – above and beyond 50%)
- Increased Public Safety (not a major issue)

- Regional Economic Development Benefits (otherwise accruing outside of the U.S.)
 - Increased tax revenue into the Harbor Maintenance Trust Fund (per-passenger cruise ship fee).
 - Increased local tax revenue
 - Dockage fees, wharfage fees, pilotage fees, security fees
 - Major tourism, recreation expenditures, and multiplier effect
 - By passengers
 - By crew and staff

Operational savings for cruise ships were not calculated since it's unclear whether the addition of Key West to the current list of ports visited by the largest cruise ships would result in decreases or increases in transportation costs. Such changes would be dependent on how cruise lines planned to add Key West to their itineraries. Determining potential increases in cruise line profits, or decreases in the cost of cruises for consumers, would both be require performing a detailed analysis of potential re-routing. An analysis of this re-routing was beyond the scope of this study.

Improvements in the quality of the experience for consumers (consumer surplus) was also beyond the scope of this analysis because of the time and cost involved in such an effort. However, the quality of the experience would be expected to increase since cruise lines expressed a preference for including Key West in its routes until the latest generation of cruise ships grew too large to navigate the harbor. Consultations with the cruise lines confirm their interest in adding the port back into their routes.

A.5.3 Benefits Methodology

For a reconnaissance level report a limited examination of potential benefits is most appropriate. This study estimates benefits primarily as increased economic activity caused by an increase in cruise traffic, induced by a wider channel (**Table A-9**).

The benefit estimates begin with a forecast of new ship calls at Key West. That is, the number, size, and frequency of ships that would call at Key West under future with project conditions. The estimates range from 1 to 4 new ships each calling anywhere between 12 and 52 times per year.

The next step in benefits estimation is passenger and crew spending. Assumptions include the number of passengers and crew per ship (3,500 -5,400 and 1,000-2,165, respectively), the percentage who disembark (25%-98%), and the per-person spending per visit (\$32-\$66). These amounts are used to estimate a total economic impact per year for passenger and crew spending. A similar method is used to estimate impacts from ship expenditures and taxes paid.

Substitutionary losses to Puerto Rico (PR) and the U.S. Virgin Islands (USVI) are calculated proportional to those territories' overall share of the Caribbean cruise market. There would be *some* substitutionary impact which would induce losses to PR and the USVI, however the effect is over-estimated in this report. This table assumes losses proportional to those territories' share

of the overall Caribbean cruise market. In reality, the geographic nature of cruise itinerary planning leads to ports competing in large part based on location. The locations of Key West and PR/USVI are actually complimentary, not substitutional. Also, this calculation assumes a zero-sum market for cruising which is extremely conservative.

Costs are over-estimated at \$40 million and a potential benefit-to-cost ratio was calculated for each estimate (2.4 - 29.3). Implan input-output software was used to calculate an estimate of full-time-equivalent jobs created (147 - 1,824). Producer surplus, consumer surplus, value of wrecks averted and expected lives saved were not calculated for this report, though some of them could be significant and could be calculated given more time and resources.

Most of the assumptions used to calculate the benefit estimates on the following page are conservative. For example, it was assumed that a certain level of cruise traffic would be induced by a channel widening project immediately, but from that point forward assumes no further growth. The cruise industry has grown 7% per annum on average over the past two decades and is projected to continue growing robustly well into the future (CLIA, 2009). Still, with so many moderate assumptions made, it is clear that the potential is high for a project that is economically justified.

Table A-9: Benefits of Widening Key West Channel

Potential Benefits of Widening Key West Channel			
\$2010 USD 4.375% Discount Rate			
Estimation Assumptions	Low	Medium	High
SHIPS & CALLS			
New Ships Calling @ Key West	2	3	4
Calls Per Year	24	48	52
PASSENGER IMPACT			
Passengers per Ship	4,000	4,500	5,400
% Disembarking	70%	85%	98%
Total New Passenger-Visitors	134,400	550,800	1,100,736
Spending per Visitor	\$40	\$50	\$55
Economic Impact per Year	\$5,376,000	\$27,540,000	\$60,540,480
CREW & STAFF IMPACT			
Crew & Staff per Ship	1250	1500	2165
% Disembarking	30%	35%	40%
Total New Crew-Visitors	18000	75600	180128
Spending per Crew Member	\$40	\$50	\$62
Economic Impact per Year	\$720,000	\$3,780,000	\$11,167,936
SHIP IMPACT			
Total New Ship Calls	48	144	208
Spending per Call	\$12,000	\$22,500	\$54,000
Key West Net Tax Proceeds	\$264,835	\$1,085,351	\$2,169,000
Economic Impact per Year	\$576,000	\$3,240,000	\$11,232,000
BENEFITS & COSTS			
Total Economic Impact / Year	\$6,672,000	\$34,560,000	\$82,940,416
Losses to Puerto Rico (10%)	(\$667,200)	(\$3,456,000)	(\$8,294,042)
Losses to USVI (20%)	(\$1,334,400)	(\$6,912,000)	(\$16,588,083)
Total Average Annual Benefit	\$4,670,400	\$24,192,000	\$58,058,291
Present Value, Total Benefit	\$94,204,662	\$487,966,595	\$1,171,069,223
Total Cost	\$40,000,000	\$40,000,000	\$40,000,000
Total Average Annual Cost	\$1,983,087	\$1,983,087	\$1,983,087
NET BENEFITS	\$54,200,000	\$447,970,000	\$1,131,070,000
BENEFIT TO COST RATIO	2.36	12.20	29.28
JOBS CREATED			
Full-Time Equivalent Jobs	147	760	1,824

A.6 The Four Accounts

Evaluation of alternative plans during a feasibility study is accomplished using the following four accounts established in the Corps' Principles and Guidelines to facilitate the evaluation and display of effects of alternative plans (ER 1105-2-100): National Economic Development (NED), Environmental Quality (EQ), Regional Economic Development (RED) and Other Social Effects (OSE). A cursory review of each account is included below.

Table A-10: The Four Accounts: Description, Effects & Magnitude

The Four Accounts: Description, Effects & Magnitude	
Effect & Magnitude	Account & Description
<p>Positive +++++</p>	<p>National Economic Development (NED) This account displays changes in the economic value of the national output of goods and services. This account is best measured by net benefits. For this project net benefits are expected to be positive and very large. Net benefits could be in the order of magnitude of hundreds of millions of dollars.</p>
<p>Negative -----</p>	<p>Environmental Quality (EQ) This account displays non-monetary effects on ecological and environmental resources including both the positive and adverse effects of Federal plans. This project is anticipated to have a significant negative effect on environmental quality. Widening the channel would have significant and negative effects on an unspecified amount of coral lightly distributed over approximately 17 acres. The project would also have negative effects on an unspecified amount of critical environmental habitat. Increased cruise traffic, as with an increase in any waterborne commerce, would likely also cause an increase in water pollution and turbidity. However, the increased tax revenues caused by the projects could also be used to mitigate these or other negative environmental impacts.</p>
<p>Positive +++++</p>	<p>Regional Economic Development (RED) This account displays changes in the distribution of regional economic activity (e.g., income and employment). This account would vary similar to the NED account: positive, potentially with increased employment and income in the region. It may also cause some loss of regional income in the U.S. Virgin Islands and Puerto Rico, though this is not certain to happen (as discussed previously in this appendix).</p>
<p>Unknown +/-</p>	<p>Other Social Effects (OSE) This account displays plan effects on social aspects such as community impacts, health and safety, displacement, energy conservation, culture, aesthetics and others. This project is expected to have positive and negative OSE impacts. Positive effects could include increased community cohesion if increased economic activities allow a more stable local economy. Increased urban congestion, pollution, and noise could be expected to accompany additional tourists.</p>

A.7 Conclusion

The purpose of this report is to determine whether or not there is a Federal interest in studying the feasibility of constructing a Federal channel widening project in Key West. This economic appendix shows sufficient evidence to conclude that from an economic viewpoint there is a Federal interest. Future with project conditions for Key West Channel widening in Cut B has reasonable potential to generate NED benefits in the hundreds of millions of dollars at an economic cost for a fraction of the initial investment.

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